No 10 JULY, 1842

CALCUTTA JOURNAL

OF

NATURAL HISTORY:

EXHIBITING A VIEW OF THE

PROGRESSIVE DISCOVERIES

IN

INDIAN ZOOLOGY, BOTANY, GEOLOGY,

AND

Other branches of Natural Science.

CONDUCTED

BY JOHN M'CLELLAND,

BENGAL MEDICAL SERVICE

TO BE CONTINUED QUARTERLY.

Communications and orders for the work to be sent under cover to the Editor.
In London Communications and Orders will be received by OSTELL and Co "*Oriental Library,*" 88, *Leadenhall Street*

Mofussil subscribers who have paid in advance are entitled to receive their Numbers Post Free.

Price to subscribers 16 Rs. per annum.

Bishop's College Press.

Contents.

THE CALCUTTA JOURNAL OF NATURAL HISTORY.

On East Indian Isinglass, its introduction to, and manufacture for, the European Market. By the Editor.

Having called attention to the subject in the March Number of the *Journal of the Asiatic Society* for 1839, p. [illegible], and again in the *Researches of the Asiatic Society*, for October of the same year, it was our intention to remain silent regarding Bengal Isinglass, with the view of allowing the article to work its own way in the English market.

But the appearance by the January mail of the proof sheets of a pamphlet by Dr. Royle on this subject, renders a few observations necessary, in order that the information before the Government may be as complete as the results which have been ascertained are capable of making it.*

* Dr. Royle's valuable Report on this subject has been reprinted in full in our last number, together with additional notes of our own.

Dr. Royle's pamphlet comprises all the information he has been able to collect in his office at the India House, as well as the opinions of brokers, dealers, and consumers, as to the defects of the Bengal compared with the Russian Isinglass. It also contains, what was very much desired, a detailed chemical analysis of the Bengal article, all which will be of service to those who are engaged in preparing Isinglass in this country.

Much information has, however, been collected in India, that has not been officially reported to the Government, nor published; and some also has been published in the two last numbers of the *Calcutta Journal of Natural History*,* which Doctor Royle could not have been aware of when he wrote; so far therefore his pamphlet is deficient, and it is to supply this deficiency that we now enter upon the subject.

Having found, in December 1839, that notwithstanding the publication in Calcutta of several statements in which the advantages of making Isinglass from fishes in the Hoogly were pointed out, still we found that no one had taken up the article with a view to the European market, and the little that was collected by the fishermen, was purchased, as usual, by the Chinese in a rough state, with as little competition as if nothing whatever had been published on the subject.

Such being the case, we felt that it would be altogether waste of time to write more about it, and instead of doing so, we desired our servants to collect the article from the fishermen, the same as the Chinese were doing, and at the same rate, or a slight advance if necessary. In the course of about a month, by going from village to village along the banks of the Hoogly and Salt-water lake, our *khitmutgar* collected altogether about 45 maunds.

A maund consists of about 200 impure dry fish bladders,

* Nos. 7 and 8 for 1841, pp. 450, 615.

and the rate charged for these was 4 rupees per score, or 40 rupees per maund. It was necessary to buy them by the score, because it seldom happened, that so many as a maund could be had at any one place. In the hands of petty dealers, who collected from the fishermen for the Chinese, three or four maunds were occasionally met with; but as far as we have been able to learn, there is every reason to doubt the accuracy of Mr. Remfrey's statement, quoted by Dr. Royle, page 32, in his pamphlet, that in one village on the Salt-water lake, the Chinese obtain from 800 to 900 maunds for the Chinese market.

On the contrary, we think the transactions of the Chinese in this article in the vicinity of Calcutta has been extremely small; for although we advanced a higher rate for the article than the Chinese ever gave, in order to secure all, or as much as was collected, with a view to ascertain the extent of the trade, yet we only succeeded in obtaining 45 maunds the first year, and the following year, 1840-41, at the still further advanced rate of 50 to 55 rupees a maund, we only succeeded in obtaining 75 maunds.

We are therefore led to the conclusion, that so far from finding supplies ready to our hands in any one place, to the extent stated by Mr. Remfrey, we must look for large supplies of the article in the improvement not only of the demand, but also of the means, which European capital and intelligence can alone supply.

We commenced collecting Isinglass in December 1839, then nearly the end of the season, only because we found the object neglected. Had we not taken this step, on finding no one else disposed to set the example, we are strongly impressed with the conviction, that Bengal Isinglass would still be unknown as an article of import in the English market.

The following is the upshot of the first year's operations, which, if viewed merely as a mercantile speculation, must be

regarded as a decided failure, as it has left us upwards of 2,000 rupees out of pocket.* If, on the other hand, it be regarded as an experiment, by which the value of an article unknown before in the European market was to be tried, we think it has been eminently successful, and must lead to permanently useful and beneficial results.

Those who have purchased the first investment at 1*s*. 7*d*. per lb. in 1840, appear to think "that 3*s*. 6*d*. per lb. is nearer the price that it would now (1841) bring." No process of mere reasoning or of argument, however conclusive, could have led to this result. Nothing, in short, but an extensive trial of the article, such as that which has been afforded at our expence, could have demonstrated the value of East Indian Isinglass, to the satisfaction of brokers and consumers.

There was no other way in which that trial could have been made, but by taking its responsibility entirely upon ourselves. We felt assured, that an application for an advance of public money for such an object would not be attended to, and even if it could, that we could not make it; on the other hand, we felt perfectly satisfied as to the importance of the object, and that there was no other way in which the experiment could be made than by taking it solely upon ourselves.

* It will be seen by the annexed extracts from correspondence with the Government that this sum has been liberally reimbursed to us.—Ed.

ISINGLASS ACCOUNT 1839, 1840.

Dr.

Date	Particulars	Rs.	As.	P.
1839.	Calcutta.			
Dec.	Advances paid by myself to Fishermen for 8,825 fish maws, at 4 Rs. a core. (about 40 Rs. a Maund.)	1,750	0	0
1840. Jan. 8	Paid to coolies and for petty charges and cleaning or converting them into Isinglass...	100	0	0
,,	Paid to Messrs. Cantor and Co. for 5 chests lined with tin for packing Isinglass....	30	8	0
,,	Paid for 30 ditto, made to order in the bazar.	123	12	0
Feb. 5	Paid to my Agent Messrs. Cantor and Co. for insurance and sundry charges of 35 chests of Isinglass per *John Colvin* as per their Ac. Cur. with me.	756	0	0
Mar. 14	Paid to ditto for Shipping charge and Export duty on 35 cases of Isinglass per *John Colvin* as per Account Current.	163	13	0
,,	Paid to do. for damering and coopering 35 chests of Isinglass.	24	6	0
		2,948	7	0
	To Interest from Dec. 1839 to Feb. 1841, being 1 year 2 mths. for 2,948 · 7 · 0 at 4 per Ct....	137	9	6
	Co's. Rs.	3,086	0	6
	£	321	5	1

(Signed) J. M'Clelland.

Cr.

Date	Particulars	£	s.	d.	£	s.	d.
Lot J. M. 4—10.	By an account of sale of above Isinglass per *John Colvin* sold at public sale 2d. Nov. 1840. 35 Cases weighing net 2,235lbs. at 1*s*. 7*d*. per lb.				176	18	9
	CHARGES.						
Dec. 5	Freight from Calcutta, ...	32	0	0			
	Interest on ditto to prompt, ...	0	5	5			
	Fire Insurance, on £ 1000 at 2*s*. 6*d*. per Cent.	1	5	0			
	Marine Insurance from Calcutta, ...	27	1	8			
	Import rate and Ware House rent, ...	4	15	1			
	Warehousing entry, ...	0	4	6			
	Fee to officer, and amending entry, ...	0	17	6			
	Advertising and printing Catalogues	1	1	0			
	Receipt, stamps, and petty charges.	0	5	0			
	Brokerage 1 per Cent.	1	15	4			
	Commission $2\frac{1}{2}$ per Cent. ...	4	8	0			
					73	18	10
	£				102	19	11

London.
31*st*. *December*, 1840.

(Signed) J. Cockburn & Co.

From 14th March 1840, when we transferred the article to our agents, Messrs. Cantor and Co., we left every thing connected with its shipment and sale on our account to that firm. It is due, however, to the liberality of H. M. Low, Esq. one of the partners in the late firm, to say, that he offered to take the risk of the investment on himself, and to repay to us the 3,086 : 6 : 0 Rs. which it had then cost us. This very kind and liberal offer of Mr. Low, we considered it our duty to decline. The experiment was undertaken with a public view, and any private arrangement, such as that proposed, we conceived might alter the character of the transaction, as far as we were individually concerned.

The sample of Isinglass therefore which Dr. Royle states, page 31 in his pamphlet, to have been the first received at the India House, and which was sent to him on the 30th October 1840, by Mr. Cantor, with a note, stating that it was a specimen of a consignment sent by his house in Calcutta, belonged to, and formed a part of that which was prepared by us, and sent at our own expence and risk through Messrs. Cantor and Co., to the London market for trial, consisting as already stated, of 2,235 lbs.

Whether the specimens subsequently presented by Messrs. Rogers and Remfrey, and alluded to, page 31, in Dr. Royle's pamphlet were derived from our stock, is of little consequence, as the public sale at which the 2,235 lbs. were disposed off, took place on the 2nd of November, only three days after the first specimen had been received at the India House.

We have been thus particular in stating the circumstances and views under which the first investment of Isinglass sent from India to the European market was made, because we regard the subject of very great importance, and are desirous of placing the facts connected with it in as clear a light as possible.

The only other person besides ourselves, who took any

practical interest in the subject during the season of 1839-40, was Mr. G. T. F. Speed, who after our own operations had created a stir amongst the fishermen, appeared for the first time to have entered the market, if we might so express it, as our rival; but whether Mr. Speed's experiment was of such dimensions as to create any very serious impression in the Home market, or to produce satisfactory and conclusive results, or whether it would ever have been undertaken but for our example, we cannot take upon ourselves to say. Thus much, however, we have much pleasure in stating, that Mr. Speed was, in our opinion, perfectly successful in rendering his Isinglass as pure and free from fishy smell, and in every way as neat, as Russian Isinglass.

The opinions of brewers and brokers as to the quality of the first investment were so unfavourable, that had they not been in some respects directly opposed to what we had ascertained before hand to be the properties of the article, as well as contradictory among themselves, we should have been disposed to abandon all hopes of the article.

In October and November 1839, we were employed in an investigation of different kinds of fishes yielding Isinglass in the Hoogly, as well as the properties of the article as afforded by different fishes. The following are the results as regards the latter part of the subject:—

Sort of Fish.	*Per cent. Gelatine.*	*Per cent. Albumen.*	*Quantity tried of each.*
Large Suleah, ...	93.4	6.6	100 parts.
Small Suleah, ...	86.7	13.3	100 ,,
Small Bola, ...	87.0	13.0	100 ,,
Small Silurus Rita, ...	67.0	33.0	100 ,,

From the above results we were satisfied, that the complaints of the brokers and brewers of the large size, thickness, &c. of the Indian Isinglass resulted from prejudice;

as the largest and thickest sounds, or those of full grown adult fishes, seemed to be the purest Isinglass. We are aware of the *bulky* appearance of the little albumen contained in the large Sulea Isinglass, but if this be collected on a strainer and dried, it will be found to amount to no more than 6 per cent., 94 per cent. nearly, being pure gelatine which is entirely soluble, yet the large Sulea Isinglass was declared by some to be *insoluble.* In small Sulea and other smaller fishes, the results were more unfavourable.

Others protested against the smell, which they declared to be peculiarly offensive. Our Isinglass, after eight or ten day's exposure only to the sun and dew, had lost completely its fishy smell before it was packed; it is probable, however, that it had been packed too fresh, and that the packages may have got damp on board ship, or perhaps in the Custom-house or other stores at home; in that case the smell would be very offensive, but the article might still be perfectly freed from smell again by re-exposure for a time to dry air. We cannot exhort merchants and others too much as to the importance of having Isinglass perfectly dry when packed, and well aired when offered for sale.

We would therefore recommend exposure to the open air for months before packing, and that the packages should be small, not exceeding ten lbs. each. Our packages were large chests of eighteen cubic feet each, and from which the article ought to have been removed and well aired in London before offering it, either as samples or for sale. The package of the article during so long a voyage is a subject of much importance.

We cannot take upon ourselves to say how far the article may have been injured after it left our hands by exposure to a hot sun in the month of March, when passing the Custom-house, and other forms prior to shipment, or what injury it may have sustained from damp or other causes on board ship, or in the docks and stores in London.

We are of opinion, that small gunny, or coarse canvass bags would be the safest and best package, but on this subject experience will be the best guide. Doctor Royle has omitted to point out how the Russian Isinglass is packed, and to consult the brokers on the best methods of packing the Indian article. The great fault complained of was the smell, a fault which it must have acquired after it was packed, and had left our hands, and which the lapse of time during the voyage could not account for. In March 1840, we had about 15 or 20 seers of the article left, which was not enough to make an uniform package. It was therefore allowed to lie, during the ensuing rains, neglected in a damp cellar until the November following, when the complaints of the brokers arrived regarding the smell of the despatch sent home for sale.

But so far was this neglected sample from having contracted any bad smell, that it had on the contrary lost *every trace* of that which it originally possessed, a fact to which we cannot attach too much importance. The greater size of the packages, and their closeness from having been soldered, and exposure to sun in this state during shipment, or to wet on board ship, or to rain in England, are the only causes to which we can ascribe the smell complained of in the investment sent home; but we are perfectly satisfied that the fishy smell of Isinglass may be altogether removed by continued exposure to the air; this may be as well effected in Europe after removal from the original packages as in India. But if this be considered an injury to the article in the European market, it will only be necessary for those who are engaged in its preparation in India, to adopt more precaution for its perfect removal, by care in cleaning in the first instance, and subsequent airing before packing, as well as by attention to the description of package.

The arrangements for future operations in this article were shaped according to the advices received from Messrs.

James Cockburn and Co., relative to the above experimental investment, due allowance being made for the prejudice of brokers and consumers. Their first letter on this subject is dated 4th May 1840, in which they say, "Isinglass advised is a new article from your quarter. We shall have great pleasure in doing all in our power to have it well shewn, and to obtain the highest value for it, as we cannot but feel an interest in the introduction of a new article of import." In their second letter, dated 31st October 1840, they enclose the opinion of different brewers as to its value.

Truman, Hanbury, Buxton and Co. state, that the sample submitted to them was not *sweet,* and that if it were so, it would be worth 3*s.* to 4*s.* 6*d.* per lb. if it yielded well in testing, but they add, Isinglass is a very difficult article to judge of by appearance only. Messrs. Cockburn and Co. therefore enjoin greater care in cleaning, and state, that if put up in the manner of Russian Isinglass, it would command at least 4*s.* to 5*s.* per lb., and they enclosed in their letter a piece of Russian Isinglass worth 12*s.* per lb. to which our own appeared in every respect equal in quality. The only difference appeared to be in size; the Russian staple weighed only about an ounce, while the Indian varies from six to fourteen ounces, the produce of each fish being so much in favour of the latter; the nature and properties, texture, and structure of both being economically and chemically the same.

The third letter of Messrs. Cockburn and Co. to their correspondents in Calcutta, is dated 4th November 1840, two days after the public sale. They state, that they had taken considerable pains to have the Isinglass well shewn, and to obtain the best opinion of its value, and also the probable quantity that could be safely sent to the London market.

"The first point," they say, "for your friend," (alluding to us,) "to consider, is to make it up in a state for consump-

tion, which should be done by carefully cleaning the bladders as soon as they are taken out of the fishes, scraping off all fat and fleshy or skinny particles, and to get off entirely the *thin skin* in the inside of the bladders, wash them carefully in fresh water, and then dry them in the sun.

"When the process is complete, they will be of one uniform colour, clear, and transparent, and free from all fishy smell, and *if they arrive* in this state, they will probably sell for as much as *5s.* per lb., but we think you may safely calculate upon getting *3s. 6d.* for any quantity up to 50 or 60 tons in the course of the year. If, however, they are very successful in bleaching, a larger quantity may be sent. It is stated to be a description of glass only suited to brewers, who take Brazil Isinglass chiefly for their use, which is now worth *2s.* to *3s. 6d.* per lb. This glass leaves a large residium when melted, unless mixed with an acid which renders it of no value, except for brewers, otherwise it would command a higher value."—*Letter of Messrs. J. Cockburn and Co.*

We have now to notice how the operations thus commenced have been followed up. In the months of August and September, the fishermen represented the necessity of making advances to them before November, the season when Sulea fishing commences, in order that they might be enabled to make preparation for taking the largest possible quantity of fish. Their representations appeared perfectly fair and reasonable, and we conceived it to be highly desirable to know what quantity of fish could be procured under the arrangements they proposed.

The results of the sale of the last investment were however still unknown, so that advances could not be made with safety to the extent that was necessary; some seven or eight hundred rupees were, however, given out in small sums for the construction of nets, boats, &c. to some forty or fifty

villages, and about the end of November the article began to come in, and continued to arrive in the proportion of from one to three maunds a day for about six weeks, when we found the whole amount furnished did not exceed 75 maunds, although the prices rose in consequence of competition towards the end of January to 50 and 55 rupees per maund.

The advices from England having arrived, the next object was to improve the manufacture, and as pointed out in Messrs. Cockburn's letter of 4th November 1840, to make up the article in a state for home consumption. Our intercourse being now fairly established with all "*interests* in *the trade*," we became acquainted with a family who had been in the habit of accompanying the fishermen for the purpose of obtaining fresh fish sounds, which they pull out into shreds in imitation of the European form of Isinglass as described by Mr. Remfrey, page 32, in Dr. Royle's pamphlet, a form that appeared to be admirably suited to the English market.

Our fish sounds were, however, dry and hard, so that it became necessary to bring them back to their original soft state before they could be converted into the shredded state. With this view, they were soaked in lime water for twelve hours, and cleaned in the same manner as the Isinglass of the first year 1839-40; in addition to this treatment, they were next steeped in alum water a short time, and then spread out on cotton clothes, also saturated with the same, and rolled tightly up in the folds of the cloth, and left overnight covered to prevent evaporation; on opening the damp cloths the following morning, the fish sounds were found perfectly soft, as in the first instance when removed from the fish, and such parts as were cleaned properly quite white. In this state the Isinglass may be either pulled out into shreds, or pressed as thin and flat as is desired, by passing it between double rollers. After the manipulation

is completed, and the article is reduced to the form intended, a little fine chalk is to be dusted over it, which prevents the soft pieces from adhering to each other. This if found at all injurious, may be avoided by spreading the fresh Isinglass on cloths to dry at once, when the chalk would be unnecessary. The only thing necessary to be guarded against in using the chalk is, that when it is once applied to the Isinglass, we cannot attempt to alter the form of the latter by further pressure or manipulation, otherwise we press the chalk into the soft surface, or even into the substance of the Isinglass, from which we cannot afterwards remove it by any subsequent process; it thus destroys the transparency and natural appearance of the article, without however any injury to its properties; for, as Dr. Royle remarks, the chalk will subside in solution.

The greater part of the Isinglass we prepared during the second year was in the shredded form, the rest was passed between rollers. The first is the most expensive mode of preparation. We had the shredding part of the process done on contract at eight annas per seer.

The sample submitted to Government, 17th February 1841, for transmission to the Honorable Court of Directors, consisting of 28 seers, both of the rolled and shredded sort, and subsequently, as suggested in the letter of Government, General Department, No. 324, under date 24th February, a second chest consisting of 33 seers of the shredded Isinglass was also submitted, for transmission to the India House. In all 61 seers, instead of 46,* as stated by Dr. Royle, page 33, had been thus forwarded at the request of Lord Auckland, who evinced much interest in the subject. His Lordship, however, conceived that it might be objectionable to allow a servant of Government to enter upon experiments partaking so much of the character of speculations, upon which we transferred our interest in the second year's ope-

* *Calcutta Journal of Natural History*, 1842, page 93.

rations in the article to Messrs. Cantor and Co., continuing however, to conduct the experiment as if it were still on our own account, until all the article on hand, consisting of 47 chests of Isinglass, exclusive of the two chests presented to Government, were completed, the whole amounting to about 50 maunds of 80 lbs. each.

The outlay, exclusive of interest, insurance, and shipping charges for this quantity was 6000 rupees, including the cost of the impure article as extracted from the fish at the advanced rate of 40 to 55 rupees per maund;* also package, the erection of a shed, and the additional charge of 8 annas a seer for shredding nearly two-thirds of the whole quantity, which last item might have been saved had we known the prejudice in the English wholesale market, (referred to p. 36, Royle's pamphlet,†) against things in a powdered or cut state. Yet under all the disadvantages of having to feel our way here in the manufacture of a new article, and our ignorance of the form best suited to the market at home, the outlay in India, including all expenses, amounted to no more than 120 rupees per maund, or 1/8 per lb., and unless the objection to the shredded form operates unfavourably in the wholesale market, the article will fetch 3*s.* 6*d.* per lb. Mr. Cantor, one of the members of the firm to which the article was transferred, and who being himself in London at the time of its arrival, commenced disposing of it to retail dealers at 3*s.* 6*d.*, but after the failure of the house, the assignees will not perhaps take the same interest in the article, and the brokers in the wholesale market will thus be able once more to obtain it at their own terms. The 4000 lbs. of which this investment consisted, (including the two chests forwarded to the India House,) together with the 2235 lbs. of the preceding

* It is procured at Arrakan and Moulmein at 30 rupees, and if extensive means were employed, might be had for still less; vide *Calcutta Journal of Natural History*, 1841, pp. 452, 614.

† *Calcutta Journal of Natural History*, 1842, p. 95.

year, the whole of which we collected and prepared, amounting nearly to three tons, will render the article well-known, and tend to establish its value in a way most likely to remove all difficulties and uncertainty in future operations in regard to it.

In describing the article, page 35 in his pamphlet, Dr. Royle describes the samples he received from Messrs. Cantor and Rogers, as of a different kind from what he received from us. We can explain this by stating, that Messrs. Cantor and Rogers' specimens were merely samples from our own first investment, consisting of the fish sounds simply split open, the external and internal membranes removed, and the air vessels washed and dried. These specimens are described by Dr. Royle as of "oval shape, nine inches in length, and five in breadth, and at least a quarter of an inch thick; *opaque*, of a brownish colour externally, but beautifully white, even silky-looking when thin pieces are stripped off. These specimens," Dr. Royle states, "had neither taste nor smell, but as they were only few in number, the *smell could not be judged so well as when in bulk.*" We have placed in italics, such parts of this description as we think wrong. These specimens were, or ought to have been translucent when held against the light; but strips removed from the mass are opaque, as well as the mass itself, when either surface is broken.

Secondly, we think it would be wrong to imply that the true way of judging of the smell is in *bulk*, merely because the article has been sent home in bulky packages of eighteen cubic feet; for if this be found to cause the article to smell, the packages may be made as small as we like, and it is quite enough to know, that when the bulk is separated, as it must be before the article can be used, it loses its smell like the samples presented to Dr. Royle by Messrs. Cantor and Rogers. We have dwelt on this point as one of vital consequence; the samples in question having been mere aver-

age specimens of an investment of 2235 lbs., which was sold at a loss, because it was said to smell.

Dr. Royle next describes the samples which we sent through the Government to the India House, which he says, "are from six to twenty-four inches long, and about three or four inches broad, and from 1-6th to 1-10th of an inch thick, white in colour, rough in some places, apparently from adhering portions of membrane stripped off; smooth and translucent in others, and occasionally nearly transparent in some, &c." One would suppose this to be quite a different article from that which was presented by Messrs. Cantor and Rogers from our first year's manufacture, but its peculiarities depend on the oval substance (or air-bladder) having been divided and drawn out, when soft, between rollers, and subsequently dusted over on the surface with lime, a mode of preparation which we did not employ in the samples presented by Messrs. Cantor and Rogers.

Having now explained what has been done in the manufacture of Isinglass, particularly by ourselves, we turn with more satisfaction to what has been accomplished by others, as far as we are in possession of information on this important subject. J. G. Malcolmson, Esq. of the firm of Forbes and Co., Bombay, in a note to our address dated 25th March 1841, states, "I have already prepared Isinglass here of course from your (meaning the Calcutta) "Polynemus," and from a fish with large scales." Soon after the receipt of Mr. Malcolmson's note, we were favoured by Sir James Carnac on his departure from Bombay, with information collected there by Dr. Heddle at the request of Lord Auckland. The substance of which is, that the article known in commerce as *Fish Maws*, is the swimming bladder of a species of fish, which attains 2½ to 3 feet in length, and is very common, at certain seasons, all along the coast.

This fish, of which Dr. Heddle has been kind enough to send a specimen, proves to be the same as our Bengal spe-

cies, and is in fact *Polynemus Sele*, Buch. Dr. Heddle states, that at Bombay this fish is called *Dara;* at Scinde, (where it proves, as originally suggested by us, to be the source of the cod sounds alluded to as an article of export from Kurachee) it is called *Seer*.* The substance extracted from the *Dara*, as well as two other species on the Bombay coast, which we shall presently notice, is called *B'hāt* by the Mahrattas, and *P'hāt* by the Guzeratees and Scindees. *B'hāt* is collected by the fishermen, and sold to a certain class of Mussulman merchants, called *Khojah*, who export it largely to China.

The principal portion of the *B'hāt* exported is collected, Dr. Heddle states, from the *Dara;* the best is from Scinde, and sells for 20 to 25 rupees per maund. This fish Dr. Heddle states, frequents the whole of the western coasts of India, particularly the coasts of Scinde, where it penetrates up the estuaries of the Indus, and is caught at Gorabari, Kurachee, and other places on the estuaries of the Indus. *Polynemus Sele*, or *Dara*, appears from the statement of Dr. Heddle to afford the best *B'hāt*, or fish sounds, as well as the largest supplies. The fish itself is also highly esteemed as an article of food.

The second kind of fish affording this article, attains, according to Dr. Heddle, four feet in length, the usual size is from $2\frac{1}{2}$ to 3 feet, and is caught in great abundance about Bombay, the flesh of which is reckoned wholesome by the

* We were not unprepared for the confirmation of this important fact, as the species was found by Bruce, the African traveller, to frequent the coasts of the Red Sea, although as Cuvier remarks, "par une de ces étourderies dont son livre est rempli, il ecrit au bas de la planche le nom de *binny*, et il lui applique dans son texte tout ce qu' il avoit recueilli sur le vrai *binny*, qui est un poisson du Nil, du genre des barbeaux (le *Cyprinus binny*, Forsk et Gmel.) Il n'y a point de Polyneme dans le Nil, et c'est uniquement sur cette mèprise de Bruce qu'est fondée l'espéce du *Polynemus Niloticus* du Shaw."—*Hist Nat. des Poissons*, t. 3. p. 288.

natives, and is very generally found in the Bazars with the air bladders extracted, having been previously removed by the fishermen, who sell them in a fresh state to the *Khojah* or *B'hāt* merchants, who dry them for exportation. The name of this fish, both at Bombay and Scinde, is *Gol.* We have also been indebted to Dr. Heddle for a specimen of this fish, which we identify as a species of *Bola,* indicated by Buchanan as a variety of his *Bola Chaptis,* called *Naria* in Jessore. It will be recollected, that we identified this same species as the *Not-kadon* of the Burmese, and one of those recently sent to the Government as yielding Isinglass on the Tenasserim Coast, (*Calcutta Journal of Natural History,* vol. ii, p. 454,) and now we find it contributing largely to commerce, as well as to the common food of the people of the Malabar Coast.

Although indicated by the accurate Buchanan, this species has never been described; it belongs to the genus *Corvinus,* Cuv. The specimen received from the Tenasserim Coast, as well as that from Bombay, were too large and too much decayed to allow of detailed descriptions being made from them; nor is the drawing with which we have been favoured by Dr. Heddle, sufficiently characteristic in regard to details, otherwise we should be glad to give it publicity.

It may be sufficient, however, for the present to say, that the species is very closely allied to *Corvinus Niger,* Cuv. but of monstrous dimensions compared to the European species. From the account given of it in Dr. Heddle's letter under the local name of *Gol,* as well as from its occurrence on the Tenasserim Coast, as already pointed out, and also in the Gangetic estuaries, this species, together with the Isinglass it affords, ought to be carefully examined and investigated.

Dr. Heddle in the same letter mentions, that there is still a third species on the Bombay Coast which affords Isinglass, called *Kota,* of which he has kindly promised to forward a

specimen to us, as well as of another fish of which Caviare is prepared.

Of these fishes, which at Bombay contribute largely to the exports of that place, two have within the last few months been made known as common also on the Tenasserim Coast, where their value, as far as we yet know, appears to be less, or indeed little understood.*

The attention of the authorities in the Tenasserim Provinces, as well as Arrakan, have already been attracted to the subject, and reports from Mr. Blundell and Captain Bogle have been received, which prove, that they are engaged in collecting information, which will doubtless be the means of leading to the improvement and encouragement of fisheries.†

* A memorandum enclosed with Dr. Heddle's letter shews the amount of exports from Bombay, during the official year of 1839-40, for sharks' fins and fish-maws to be 2,82,383 rupees. The following places are given as the sources of these supplies: Malabar Coast, Cutch, Scinde, Mekran, Muscat, Bunder Abbas, Goa, the Coasts of Concan, Damaun, and Surat. Those exported from Scinde and Damaun are reckoned the best, those from Malabar are inferior. These different qualities in the *B'hāt* depend, we conceive, upon the species of fish from which it is taken, and not upon the place

† Mr. Blundell, the Commissioner of the Tenasserim Provinces, to whom at the desire of Lord Auckland, we communicated all that had been done in Calcutta on the subject of Isinglass, writes to us from Moulmein, 24th June 1841, that having given to a friend at Amherst all the information collected in Calcutta about Isinglass, he commenced some inquiries, the results of which he wrote to me as follows: "The Polynemus Sele, called by the Burmese *Káthay*, frequents our coast. I had one brought to me yesterday, which is the perfect fish described in the *Asiatic Journal.* I send you the Isinglass taken from it. The fish was about 13 inches long, and judging from the size of the sound, and its weight in comparison with the description of McClelland, I should be inclined to say, that it is infinitely superior. * * * The large specimen I found in possession of a Chinaman, and on inquiry of the Burmese, I find it is procured from the same fish of a large size. The season of their visitation in numbers, is on the approach of the dry weather, when by arranging with the fishermen, a large quantity may be collected.

It would appear from the information collected by Mr. Blundell, and referred to below, as well as in the report of Mr. E. O'Reily, recorded in the second volume of the *Calcutta Journal of Natural History*, that the Polynemus sele frequents the estuaries of the Irrawaddi during the cold season, precisely as it does those of the Ganges, and as we learn from Dr. Heddle, those of the Indus and Coast of Scinde. With regard to the Isinglass, Mr. E. O'Reily remarks, that the article never having been noticed in the Moulmein river before, it appeared difficult when he wrote, (August 1841,) to say to what extent it may be procurable. The arrangements proposed by Mr. O'Reily to the head fisherman, of erecting *stake-traps* at the mouth of the river, seemed to promise about 500 viss, or 2000 lbs., as the probable amount of Isinglass that may be collected during the dry season. Similar arrangements might be made at the mouths of the Great Tenasserim and other estuaries along the Coast.

Captain Bogle, Commissioner of Arrakan, to whom at the desire of Lord Auckland we gave in August last a specimen of the Sulea fish to shew to the people on that Coast, together with all the information in our power, soon after informed us, that the Sulea fish is found at Arrakan in great abundance and perfection. It is there called *Lukwah,* and

The large sounds, as per specimen, are at this season imported from Rangoon, and sell here at 1½ rupee per viss. The Chinaman says, the smaller specimen is much finer, and would bring a much larger price if imported with others, but I suppose the Burmese look more to quantity than to quality. I should very much like to hear McClelland's report on it, especially the smaller specimen, which I think is very fine, and certainly more plentiful in the fish here than in that described by him." The small fish alluded to in the foregoing note is the young Suleah, the large sound being afforded by the adult fish; our own observations rather prove the sounds of the adult fish to be the purest, although both Dr. Heddle and Captain Bogle state, that small sounds bring a higher price in China. the subject requires further investigation.

appears in the estuaries in shoals about the middle of January, and disappears in April; its usual size is from 3 to 4 feet long; about 10,000 of these fish, large and small, are taken annually at Arrakan.

The Mugs split these large fish open, and dry them in the sun; and until within the last few years threw the air vessel away; but since then, they sell this to petty dealers at from sixteen to eighteen rupees a maund for the large size, but twenty for the average description, and sell them again to the Chinese at 30 rupees per maund. Captain Bogle adds, the Chinese export the dry bladders to Penang, where they are in great request, and bring, it is said, forty or fifty dollars.*

Taking the value of the export from Bombay, as stated by Dr. Heddle on the best authority on the spot as our guide, the quantity annually exported from that port would be, at 20 rupees per maund, 1,129,520 lbs. Now we have found, that for every lb. of Isinglass 100 lbs. of fish must be taken. Thus supposing, as there is much reason to believe, the article exported to China as shark's fins and fish maws to be chiefly Isinglass, 50425 tons of fish must be taken to produce it. The question therefore arises, what becomes of the fish; what proportion of it is consumed fresh; and how much of it is cured? The fishermen who in two months supplied us with 75 maunds of fish sounds in December and January 1839-40, must have taken 250 tons of fish, not one-tenth part of which we believe, was turned to any useful account. Captain Bogle indeed states, that in Arrakan the Mugs split the fish open and dry them in the sun, after removing the air vessels, and sell four or five fishes in this state for a rupee without salting, or otherwise preparing them.

It is very much to be feared, that their method of curing fish at Bombay is not much better than at Arrakan, and that a vast source of prosperity and trade is thus lost not only to our coasts, but particularly to the interior, where

* *Calcutta Journal of Natural History*, vol. ii. p. 615.

fish is dear, and provisions of all kinds often scarcely sufficient for the population.

The estuaries and western shores of the Persian Gulf abound in shoals of what we now know to be a superior fish, not merely as an article of food, but also superior in the production of another article of high commercial value. We have also found, that the same species is equally abundant during the cold season along the western shores of the Bay of Bengal, where up to the present time, it has been almost entirely neglected.

These two facts are of the highest practical importance. We can infer from them, that the natives of the Malay Coast may, if they like, contribute three lacks of rupees to their exports, the same as the people on the Coast of Malabar; as they have the same fish in the same vast shoals, and the same means of fishing if they like to employ them, besides the advantage of being so much nearer to China and the Straits, hitherto the only market for *fish maws.*

But as another market is now opened for this article in a more improved and pure state, the fishermen may obtain higher prices, and thus be enabled with European assistance to bring improved means to bear upon their employment.

We have estimated the quantity of fish taken on the Malabar Coast annually from the amount of *fish maws* exported, to be upwards of 50,000 tons, of this probably not above a 10th part is made available for the supply of food, perhaps for want of salt.

What we would here recommend is, that a premium be allowed on salt fish, equal to the duty on the salt used in curing it. It would also be desirable, that attention should, if necessary, be directed to the production of salt suited to curing provisions. The best salt for this purpose, and which is used in England, is made in the south of Europe from sea water by solar evaporation, and imported as *Foreign Bay Salt.* But the native salt merely washed,

and recrystallized, would answer the purpose. There is, however, considerable variety in the native salts in different districts, but in general their impurities appear to depend on the evaporation of sea water to perfect dryness, instead of allowing the last portion of the solution, which consists chiefly of muriates of magnesia, lime, and sulphate of soda to drip off.

Salt for curing provisions should not contain above two or three per cent. of these last named impurities; whereas, if sea water be evaporated to dryness, the result will contain in addition to muriate of soda, above ten per cent. of sulphate and deliquescent muriates, which absorb moisture, and have no antisceptic properties, but the contrary. Salt for curing provisions should also be large grained, hard, dry, and coarse, but white. When such salt is used, fish or other provisions may be as perfectly cured in India during the cold weather, from the end of November to the end of January, when the Sulea fish is in season, as in any other climate.

The only other distinct propositions we can venture to urge at present is, that an experimental fishery be established at Amherst, where Mr. Blundell reports arrangements for the purpose to have already, in some degree been made, and that regular information regarding the progress of the experiment may be reported.

A figure, (Plate vi.) together with a few remarks on the history of a species promising to become so important to the commerce of India, may not be here out of place. *Polynemus plebeius*, *Polynemus lineatus*, and *Polynemus sele*, are names which have been proposed by different authors for the same species.

It was first made known to naturalists by Broussonnet, from a specimen obtained by Sir Joseph Banks at Otaiti, where it is called *D'emoi*. About the same period, Dr. John, a missionary at Tranquebar, one of the earliest, and at the same time one of the most distinguished, explorers of the

Natural History of India, communicated a figure, together with a description of the species, which subsequently appeared in Bloch's great work on Ichthyology, which appeared about the close of the last century. The figure given by Lacèpéde, was communicated by Commerson from the Isle of France, and a specimen of the fish itself, the only one we believe in Europe, is in the Royal Museum of the Netherlands. Bruce, the African traveller, also met with the species on the borders of the Red Sea, but erroneously figured it as one of the fishes of the Nile. Lastly, Buchanan Hamilton describes it as one of the species of the Ganges. Cuvier and Valenciennes, from whose great work on the Natural History of Fishes,* we have derived the above particulars, give as its habitation the whole of the Indian Seas and adjoining parts of the Pacific.

All authors who have noticed it, speak in high terms of its delicacy and wholesomeness as an article of food, and of the excellence of its flavour. Commerson found it to be confined in the Isle of France to the tables of the rich, but Dr. John found it in such abundance at Tranquebar and other places on the Coromandel Coast, as to render it extraordinary that his observations regarding it have excited so little attention in India. It assembles, he says, in the month of January when it is in season, in great numbers on the coast in search of clear water on the sand banks, and at the mouths of rivers for spawning, which takes place in April, and is taken in large numbers in the mouths of the Kishna and Godavery; each fish he describes as four feet in length, and the head in particular he remarks is reckoned above all other parts a most delicate morsel.

Buchanan merely speaks of its fine flavour and superior qualities as wholsome food, but not one of these authors appears to have noticed the remarkable value of its air bladder, which surpasses in size and also in importance that of

* We annex a translation of their remarks on the subject.

the Beluga itself. The following list of names by which it is known on different parts of the coast, may be useful in addition to the figure, which we now give, Plate VI, from Buchanan's unpublished drawings.

Sélé, Bengal, (Buchanan.)
Suleah, Bengal, (Anonymous.)
Seer, in Scinde, (Heddle.)
Dara, Bombay, (Heddle.)
Lukwah, Arrakan, (Bogle.)
Ka-tha, Tenasserim. The small or young? (O'Reily.)
Ka-ku-yan, Tenasserim, the large when in season, (O'Reily.)
Kala mine, Tranquebar, (John.)
Pole-kala, Pondicherry, (Leschenault.)

Note.—The species is distinguished by the great size of its air vessel, and by the presence of five tendrils or bristling feelers placed on the breast on either side below the pectoral fins. We have ascertained that *Polynemus quadrifiles*, distinguished by four tendrils on each side, has no air vessel whatever. We had before pointed out the same peculiarity in *Polynemus paradiseus*, so that *Polynemus Sélé*, or as it might now be appropriately named *Polynemus gelatinosus*, is not to be mistaken for any adjoining species.

CALCUTTA, *26th February*, 1842.

Extract of a Letter from Assistant Surgeon J. M'CLELLAND, *to* G. A. BUSHBY, ESQ., *Secretary to the Government of Bengal, &c. &c. &c. under date 26th February*, 1842.

As the experiments were not undertaken with the previous sanction of the Government, I cannot in consequence make any claim for the actual cost with which they were attended; but if their utility be allowed, and the results be found to prove of practical interest, I may then trust to the liberality of His Lordship for the reimbursement of that deficiency, which will appear on comparing the debtor with the credit side of the Isinglass account for 1839-1840, and also for 183 rupees, the actual cost of 61 seers of Isinglass, forwarded through the Government as a sample to the Honourable Court.

Extract of a Letter from G. A. BUSHBY, ESQ., *Secretary to the Government of Bengal, No.* 264, *to* J. M'CLELLAND, ESQ., *M. D., under date 26th February,* 1842.

In reply to your letter dated this day, submitting a full report on the results of your enquiries and experiments to ascertain the value and the source of East India Isinglass, I am directed by the Right Honorable the Governor to acquaint you, that a copy of the report in question will be forwarded for the information of the Honorable Court of Directors, and that although the Honorable Court have not yet noticed the first communication respecting the expence incurred by you in this enquiry, his Lordship is pleased to authorize you to be compensated to the extent of rupees 2,280 . 4 : 4, being the net expense incurred after deducting the amount realized at the Home market by the sale of the article experimentally manufactured, and I have to enclose a Treasury Order for the amount.

Total Expense incurred, ...	Rs	3086	0	6
Deduct:—				
Sale proceeds 102*l* 19*s*. 11*d* at an Exchange of 2*s*. 1*d*.		933	12	2
Balance,	Rs	2097	4	4
Add costs of 61 seers sent to the Honorable Court, ...		183	0	0
Net Expense,	Rupees	2280	4	1

Extract of a Letter from DR. HEDDLE, *dated Bombay, April* 26, 1841.

That form of Isinglass which is prepared by simply drying the swimming bladder of certain fish that frequents the coasts about this, is an article of export from Bombay to China. The substance is called "*B'hot* by the Mahrattas. and *P'hot* by Guzeratees and Scindees. There are three species of fish, from which the bladder is usually extracted for this purpose. The first is called by the natives of Bombay *Dara*, and by the Scindians *Seer*: it furnishes the best *B'hot*, and I believe also, the largest proportion of that which supplies the market is taken from it. This fish frequents the whole of the western coasts of India, particularly the coast of Scinde, and it penetrates up the estuaries of the Indus, where it is caught at Gorabari and other places on the Indus, to which the influence of the tide reaches. It is met with also at the mouths of the Euphrates, for an Arab merchant of Bussora, who went with my people to the bazar to procure the fish, singled out this as the one from which the bladder is extracted in the Bussora river, the estuaries of which it frequents. I have given a figure of our *Dara* in the drawing numbered 2. The fish attains the length of 4 feet at least, but the usual size is 2½ to 3 feet. It is caught in great abundance about Bombay, and the flesh, which is esteemed wholesome by the natives, is very commonly eaten. The fish are generally found in the Bazars with the bladder previously

extracted. These are taken out by the fishermen, who sell them to a certain class of Muslem merchants called *Khojah*, who are the principal dealers in this article. The fishermen sell them in a fresh state, the *Khojahs* dry and otherwise prepare them for exportation. That prepared in Bombay is the least esteemed, and the lowest priced. The reasons for this inferiority seem to be, that the substance is not perfectly dried, and is liable to be attacked with maggots. Another reason is, that the bladders are not so thick as those which are more esteemed. Damaun and the coast in that quarter furnishes the article of superior quality at Bombay, but the best of all, and the largest quantity, comes from Scinde and from the Mekran coasts. The *B'hot* of Scinde is of larger size, is well dried and hard, but generally of a darker colour than that prepared in Bombay, and this latter difference appears to be owing to the fact, that in Bombay the bladders are dried in the shade, whereas in Scinde they are exposed from the first to the sun. The best Scinde *B'hot* sells for 20 to 25 rupees per maund, and fetches in China from 80 to 90 dollars per picul of 1¾ maunds.

The second species from which this substance is prepared, is called both by the people here and in Scinde, *Gol*. This is figured in the drawing numbered 1. It attains the length of 3½ feet and upwards. It is inferior to the *Dara*, both as an article of food and on account of the quality of the *B'hot* it furnishes. However, a large quantity of the article extracted from this fish is brought to market. It is prepared exactly in the same way as the *Dara*, and sells here for 15 to 18 rupees per maund. Although the *Gol* frequents the coasts of Scinde, the people of that country say, that it never enters the river, but is always caught in salt water. No use whatever is made of the *B'hot* in Scinde; it is simply prepared and exported to Bombay, and eventually to China, nor am I aware at present that any of this substance is consumed in Bombay.

The *Khojah* were asked by my people, why they did not export their *B'hot* to England? But the reply was, that upon enquiry they found, that the demand for this article in England was very limited.

There is a third species from which *B'hot* is extracted, called here *Kota*. This fish is rare on our coast, but appears to be more abundant to the westward, especially about Muscat, where it is well known. The *B'hot* from this is universally admitted as inferior to the others, and consequently little of it is brought to the market.

The sample which accompanies this is the *B'hot* of the *Dara*, (the *Seer* of the Scindeans,) prepared in Scinde. It will shew the nature of the substance, which if prepared with care, by the process used by the

Russians would no doubt furnish Isinglass of the best quality. More detailed drawing of the "*Seer*" and "*Gol*" fish shall be communicated hereafter, with a drawing of the *Kota* as soon as one can be procured, and a drawing also of the fish from which Caviare is prepared. This substance is called *Gubolee* by the Mahrattas, and the fish from which it is procured, "*Soormaee*." The best comes from Scinde, but unlike the *B'hot* it is most prepared for home consumption, that is in India.

Extract of a Letter from the same, dated Bombay, August 9, 1841.

I had a drawing of each of the species now sent taken for you, but I imagine that Dr. Brown may not have forwarded them in the hurry of departure. The delay which has occurred in answering your letter, has arisen from my not being able to procure the third species mentioned in my note as yielding the *B'hot*, that called here "*Kota*." From the fact of my not being able to procure one since I received your letter I am led to conclude, that the habit of this fish is migratory. though the fishermen will not distinctly admit the fact. They say, it is *scarce* on this coast. I am assured, however, that I shall meet with it this month, and if I succeed, I shall despatch a specimen by the first vessel in the same manner as the last.

With regard to the habits of *Gol* and *Dara*, the enquiry I have made would lead me to conclude, that neither species is migratory. Both are caught in Bombay throughout the year. It is true at some seasons in greater abundance than at others, but this is said by the people to depend on circumstances quite unconnected with the presence or absence of the fish. About June, and again in September, the number taken is small compared to the intermediate periods. At these times, the fishermen change their ground. In June removing their tackle, &c. from the deep sea-fishing stakes, which are fixed off the west coast of the island, in the open ocean, to other stakes fixed in the piece of sea to the east of the island, and situated between it and the main land. Here the fishing is continued during the south-west monsoon; and in September they move again outside. The fish also shift their ground; at least none are taken in the inner water during the fine season.

The information I obtained last season from the Mohanas of Scinde, would lead to the same inference with regard to the stationary habit of these two species on their coast. They say, that on the coast of Scinde and the eastern part of Mekran, the fish are not taken during the S. W. monsoon, because the boats do not go out at that season. The

Dara, however, which pushes into the Indus, is caught even during that season in the estuaries of the river.

With regard to the abundance of both the kinds in question on this coast, I have been repeatedly assured, that at some seasons during the springs, the bazars of Bombay and neighbouring ports along the coast are literally glutted. This I have observed myself frequently. Vast quantities are consumed by all classes of natives in the fresh state, and likewise salted. In the latter state it is sent into the interior, but by far the largest quantity is consumed by the sea-faring population of this part, both those navigating the small craft, as well as the large. It forms with them their stock of salt provisions. In this point of view, both these fish are extremely important, and the trade in the other production of the same species (the *B'hot*) must be of secondary value to it. I will not trouble you with further details on this subject at present, but enclose an original memorandum of the ports from which the bladders of the three species yielding this substance are imported.* It will give you an idea of the quantity that must be produced, as well as the space over which the species are met with. The fish dried and salted, are imported from the same places.

I shall in the ensuing fine season induce one of the people engaged in the preparation of *B'hot* to prepare some by the method you communicated, and inform you of the result.†

Hereafter I hope to be able to furnish you with a list of all the fish to be found in this bazar at different seasons, with drawings of some, or all of them if possible. Also an account of those which the fishermen here admit to be migratory, such as the famous Pulla, which is caught in the Indus at certain seasons, and which is known also here, and another fish of small size, (the name I have forgotten,) but which is valuable as yielding a fish-oil much used on this, and the Malabar coast.

The Remarks of Baron Cuvier and M. Valenciennes, on Polynemus plebeius, Brouss.; *Polynemus Lineatus,* Lacep.; *Polynemus Sélé,* Buch.; *from the Histoire Naturelle des Poissons.*

Our first species with five filaments appears to be the *Polynemus plebeius,* of which Broussonnet has published a very exact detailed des-

* See note page 175.

† We regret to find that Dr Heddle soon after this was written, was obliged to leave Bombay for the benefit of his health, which however became worse, and death deprived us of an intelligent and obliging correspondent at Bombay, and the public of an excellent servant.—Ed.

cription.* It was Sir Joseph Banks who furnished the specimen, and who procured it at Otaheite, where it was named *D'emoi.* The sailors of the first expedition of Cook also caught them at the Isle of Tanna. In the Royal Museum of the Netherlands, there is a specimen which came from Java. It is as we have said the *Polynemus* figured by Commerson from a specimen caught at the Isle of France,† and the *Kala-mine* of Tranquebar sent to Bloch by John; we have also received it from Pondicherry through M. Leschenault, under the name of *Pole-kala.* Lastly, Mr. Buchanan believed, with every reason for the truth of his opinion, that it is the *Sélé* of the Ganges. They are therefore to be regarded as inhabiting the whole of the Indian and warmer parts of the Pacific Oceans, but we do not know where Bloch has taken his authority for its also being found in America. Admitting as we may, the identity of these subjects, we may regard the Polynemus as a fish remarkable for its fine flavour and the size which it attains on certain coasts. According to John, as quoted by Bloch, it attains in Malabar four feet in length, and we have seen in the Royal Museum of the Netherlands an individual from Java, forty-five inches in length. John adds, that it is one of those species on which the name of Royal Fish is bestowed in the Colonies, and by the traders on the Coromandel Coast, with whom the head is considered a delicate morsel; they are dried and salted, and also preserved with spices. They are seen in great quantities on the Coasts in search of clear places on sand banks in the mouths of rivers. They afford much fishing in those of the *Krishna* and *Godaveri.* They are in season in January; they spawn in April.

We found in a manuscript of Commerson, recently communicated to us by M. Hammer, that at the Isle of France, where they are named *Barbue,* they are caught in small quantities all the year, and being scarce, are reserved for the tables of the rich.

If it be the same as the *Sélé* of the Ganges described by Mr. Buchanan, it does not enjoy such a character in Bengal. This author says merely, its flesh is light, and something like that of the *Bola,* or as others say, like our *Merlan;* but that numerous species are preferable for their flavour. They are caught in great numbers in the mouths of the Ganges, and weigh from 20 to 24 lbs. At Pondicherry, they appear to be smaller, for it is remarked by M. Leschenault, that they are a foot in length; they may be taken all the year round on the coast at Pondicherry, but are not common. It will be for those observers

* Dans le premier et l' unique cahier de son Ichtzologie (Copié dans l'Encyclopédie Methodique Ichtzologie, fig. 209)

† Copied in Lacepede, t v. Pl. 13, fig 2

who reside on the spot to determine the nature of these discrepancies, and whether they are owing to varieties, or to geographical position, or to different species being confounded, from the want of means to make direct comparison of those species of which the characters differ but little. An Indian naturalist, who had only isolated descriptions of many of our Cyprins, would be very liable to overlook those differences which we have found it difficult to seize when comparing nearly allied species, and which our fishermen never mistake. But a confusion of species, for which there is no excuse, is, that which was made by Bruce, on the very species we are now describing. He has given in his Travels, (Plate 41,) an exact figure from a drawing which appears to have been made on the coasts of the Red Sea: but by one of those blunders with which the work is replete, the name *Binny* is written at the bottom of the plate, and if you refer to the text, you will find the true *Binny* is a fish of the Nile, of the genus *Barbus*, (the *Cyprinus binny*, Forsk et Gmel.) There is no Polynemus in the Nile, and on this extraordinary mistake of Bruce, is founded the species *Polynemus Niloticus* of Shaw.*

Our specimen from Pondicherry is a little shorter in proportion, the head a little larger, and the second dorsal and the anal more pointed than the *Polynemus tetradactile*, to which in other respects it bears a close resemblance. The denticules of the preoperculum are also smaller, and the inferior angle is round. The teeth are in straiter bands and descend less outside of the lower jaw. Not only has it one ray more, but the three first rays are longer than the pectoral, while in the *Tetradactylus*, they are shorter. The ventrals are situated behind the pectorals, and reach almost to the extremity of the free pectoral rays. The lateral line extends in a line from the superior angle of the operculum to the tail, on which it is prolonged a little downwards with its slope.

The number of its rays.—D. 8 . $\frac{1}{14}$ a $\frac{2}{13}$: C. 17 : P. 17. v. $\frac{1}{5}$.

Our specimen is silvery, with longitudinal grey or dark lines formed rather by reflection than true tint, and prevailing along the whole of the back to the tail. The fins are pointed and dark. M. Leschenault, to whom we owe this specimen, and who saw it when fresh, assured us, that the muzzle of the fish is transparent as gum; and Commerson* also says so. In this state, the brown lines of the back are less apparent, for M. Leschenault has described this species as grey on the back and white below the belly. Commerson has given it only one colour, a bluish silvery tint towards the back. The figure of Com-

* Shaw, Univ. Zool. t. v part 1st, p. 151.

merson, upon which M. de Lacèpéde established his *Polynemus lineatus* is in fact drawn from a dry specimen, and we are certain, that it is the same species with that which we have received from Pondicherry, since we are in possession of the original specimen as well as the original drawing, and have made a comparison with this and other individuals.

According to our observations, the Polynemus has a very large swimming bladder, thin and without appendages; its stomach is a *cul-de-sac*, and its pyloris is furnished with innumerable small cœcums.—*Histoire Naturelle des Poissons, t. 3me, p.* 281, *Paris*, 1829.

J. M.

Europe:—A popular Physical Sketch. By Professor Schouw, *communicated to the Calcutta Journal of Natural History, by Dr.* T. E. Cantor.

(Continued from vol. ii, p. 16.)

In consequence of the considerable height of the South European Mountains, the South European on ascending them arrives at climates and vegetations similar to those of the North of Europe, whereas the North European in his own country, remains ignorant of the nature of the South of Europe. Thus the Italian or the Spaniard on ascending his mountains, may see beech-forests, hazel-bushes, rye-fields, and luxuriant meadows; ascending still higher, he meets with plants of Lapland and snow at midsummer, while the North European in his own country, never knows the mild winter or the clear sky, nor sees the laurel, myrtle, nor the evergreen forests, olives, nor oranges.

The smaller extent of surface of the south of Europe, and the greater encroachment of the sea, are the causes that no rivers can equal in size those of the great plains of the north. The largest rivers in Europe, Wolga, Danube, Dnieper, and Don, appear all to the north of the great mountains, where also the lakes in extent and number surpass those of the south, particularly so in the countries surrounding the Baltic. The structure of the mountains is not very different in the north and the south. Mines are particu-

larly found in the north: England, Scandinavia, Hungary, and Saxony.

The mean temperature of the north of Europe appears to be between 27.5°* Fahr. (the supposed mean temperature on the north coast of Russia), and 56.7°, (Dax and Bordeaux); that of the south of Europe between 54.5° (Milan) and 68° (supposed mean temperature of the south coast of Sicily.) If coasts and plains solely be taken into consideration, the difference in the mean temperature is greater in the north; but the low mean temperature of the north appears also on the lofty mountains of the south; thus for instance, the mean temperature of St. Gothard is from observations 29.8°, and from a probable calculation 28.63° on the summits of Etna and the loftiest peak of the Apennines, and 5° on the top of Montblanc, whereas the highest summits of the northern mountains scarcely have a lower mean temperature than 14°.

Owing to the extensive inland plains, a greater difference in the climate of the eastern and western extremities exists in the north of Europe, than in the south, which is in immediate contact with the sea.

The coasts of the Atlantic and its islands possess the mildest climate, whereas in the south of Europe the coasts of the Atlantic have a climate less mild than the corresponding part of the Mediterranean between Spain and Italy.

The climatic difference between the north and south of Europe consists much more in the winter than in the summer temperature, which will appear by the following comparison:—

	Winter.	*Summer.*
Palermo,	52·2°*	74·°
Vienna,	32·°	68·°
Copenhagen,	30·9°	63.5°
Stockholm,	25.°	61·2°

* The temperatures were given according to Reaumur's scale; we are responsible throughout for their reduction to Fahrenheit.—*Editor Calcutta Journal Natural History.*

The difference in the summer temperature between Palermo and Vienna thus amounts to only 6°; in the winter temperature to 20.2°. The summer in Stockholm is only 13.5°, while the winter is 27.2° below the winter temperature in Palermo.

That this applies still more to the highest degrees of heat and cold,* will be seen in the table :—

		Highest.	*Lowest.*	
Stockholm;	68 years,	95·°	26·5°	below zero.
Copenhagen,	52 years,	93·85°........	13·°	ditto ditto.
Rome, ...	40 years,	100·62°........	21.88°	above zero.
Palermo, ...	34 years,	106·2°	32.°	ditto ditto.

This difference between the seasons and the proportionally great summer heat in the north, exerts a very salutary influence over the vegetation; the severe winter cold indeed checks the vital activity, but does not destroy it; whereas the high summer temperature of the long summer days, promotes the growth of the plants, the ripeness of the fruits and seeds. If there were no difference in the seasons, or in other words, had the north of Europe perpetual spring, we should in Copenhagen, for instance, never see snow or ice to be sure, but we should also never see corn or fruit ripen, nay, we should see no trees at all. In the high land of South America, under the line, where there is no great difference between the heat of the seasons, grain cultivation ceases already at 25° above the freezing point, (the mean temperature of Milan,) and the tree vegetation at 18°, (the mean temperature of Carlsruhe); if such was the case in Europe, there would exist no grain cultivation north of

* Every comparison of observations of the highest and lowest temperature is rendered somewhat uncertain, from the circumstance, that the spot where the thermometer is placed, by name the elevation over the ground, exerts a much greater influence over the highest and lowest temperature, than it does over the mean temperature. Supposing even the data in the Table be incorrect, say one or two degrees, the correctness of the statement will be apparent nevertheless.

the Alps, and no forests north of Paris, Carlsruhe, Prague and Ofen.

The salutary influence of the change of seasons becomes also apparent on comparing the coasts and islands of the northern parts of Europe, with the interior of the Continent. Iceland and the Fär-island produce neither forests nor corn, while both flourish on a much more northerly latitude on the Continent, where the summer heat is greater, but the annual mean temperature is less. For the very same reason, the vine and maize limit does not extend so far northward on the west-coast of France as in Germany.

Such European plants as require a very mild winter, are of course not to be expected to grow in the north of Europe; for instance, the ever-green trees, the olive, and the orange-tree, and these therefore are peculiar to the south.

Another consequence of the greater difference between the seasons in the north, is, that the arrival of spring is much more conspicuous. The mild air relieves the severe cold, the frozen lakes and rivers thaw, the snow-cover of the earth disappears, making room for grass and herbs; the trees shoot leaves, the itinerant birds arrive, and the insects are called to life. In the south, on the contrary, where no snow hides the earth, where field and meadows are verdant in winter, and where most trees and bushes retain their leaves, the only change consists in a greater number of plants springing and flourishing, a greater number of trees shoot leaves, and a greater number of birds and insects make their appearance. The arrival of spring forms there a much less important era in the life of the husbandman, who, the whole of the winter, may work in his field, garden, vine, or olive yard.

The annual quantity of rain depends on the locality and physical condition of the countries to such a degree, that it is impossible to produce any thing like a comparison between the northern and southern Europe. In lofty mountain districts, the quantity of rain is very great, particularly on the

south and west side, whither the wind carries vapours from the warmer regions and the sea. Coasts and islands appear to receive a greater quantity of rain than the large plains on the interior of the Continent, *cæteries paribus;* the quantity appears greater indeed in the south of Europe, particularly on the south side of the Alps, and the same side of northern part of the Apennines. But the vicinity of the torrid Africa, in conjunction with the great elevation of the Spanish table-land, are the causes of the scanty annual supply of rain in the southernmost part of Europe. In the distribution of the rain, however, a great difference exists between the north and the south of Europe; in the former the quantity is tolerably equally distributed throughout the four seasons; yet the greatest quantity falls in summer and autumn. In the south of Europe, on the contrary, the summer rain is very scanty, the autumn and winter the proper rainy seasons; and the farther we advance to the southward, the more the summer rain decreases, and the winter rain increases. Also the number of rainy days is greater in the north than in the south, where the fall of rain is more rare, but the more violent. Snow, being so conspicuous in the north, (particularly towards east) of Europe, is a rare occurrence in the lower regions of the south of Europe; hail-stones, on the other hand, are much more common in the south, and there much more dreaded by the husbandman.

Lightning and thunder seldom appearing in the north, except in summer, are common phenomena in the south throughout every season, but particularly in autumn. Of an hundred thunder storms occur

	Winter.	*Spring.*	*Summer.*	*Autumn.*
In Copenhagen, ...	1	18	70	11
In Palermo, ...	15	15	22	48

The sky is much clearer in the south of Europe than in the north.

In the south of Europe, the daily changing land and sea winds are frequent, particularly in summer. During the day, the land-air is more heated than the sea-air, for which reason the air rises over the land, and pours in from the sea. At night, on the contrary, the sea-air is warmer, for which reason the land-air streams towards the sea, of such change of wind but slight traces are observed in the north of Europe. The hot enervating winds *(scirocco, solano,)* which blow in the south, are unknown in the north, where also little is perceived of the pestilential air, which infests so many tracts of country in the south.

The chief distinctions between the vegetation of the south and the north are,—the south produces a greater multitude, and by name a greater variety in species of trees and shrubs, a greater number of tropical forms of plants, of creepers and bulbs, of beautiful flowers and scented herbs; wherewithal the evergreen foliage is peculiar to the south of Europe. On the other side, the grass vegetation is much more luxuriant in the north, owing to the summer rain, which is much rarer in the south, which during that season gives an arid greyish-yellow appearance to the grass.

Although the wheat is also much cultivated in central Europe, and in some countries is the principal grain-sort, rye nevertheless is characteristic to the north; whereas wheat, maize, and partly rice are the common grain with the south European. Potatoes and buck-wheat, of great importance as food in the north, are rare in the south. Beer is common beverage with the north, wine with the south European; yet the vine-limit lies to the north of the dividing mountains. The oil and butter, on the contrary, correspond exactly to the dividing medium between the two principal parts of Europe.

In the south of Europe, vegetables and fruit are much more generally cultivated than in the north, and there is also a greater variety of oranges. Pistachios are found to the south

only of the great mountains; apricots, peaches, almonds, figs and grapes, although extending farther northward, appear in a small part only of the northern Europe, and there not unless cultivated with great care and art.

These differences in the productions must produce a considerable contrast in regard to the food of the inhabitants. Rye bread, beer, butter, a greater quantity of animal food, and a less of vegetables and fruit with the north European; wheat bread, maize, wine, oil, a greater quantity of fruit and vegetables, and less animal food with the south European.

Hemp and flax are more commonly cultivated in the north. The cotton plant in the south only, and rearing of silkworms also, is nearly exclusively confined to the south.

The wild mammalia offer no striking contrast between the north and south; the Arctic countries only possess some peculiar large animals, as the reindeer and the polar bear.

Serpents and lizards are much more common in the south of Europe, as also the number of insects and molluscs increase towards the south. The southern seas are inhabited by a greater number of species of fishes, but the number of individuals appears greater in the northern, for which reason the north European supplies the south European with fish. The most important fishes of the north are the different species of '*Torsk,*' (Brosmiusco,) and herring; that of the south is the tunny.

The domesticated animals, as well mammalia as birds, are the same in the south as in the north, except perhaps the ass and the mule, which, more common in the south, don't extend far beyond the line of demarcation, and the reindeer, which is domesticated in the northern Scandinavia.

The complexion of the south European, his hair and eyes are darker; the form of his body less clumsy; he is more agile; is thinner clad; lives more in open air; and has fewer necessities. He is more exposed to fevers, while

diseases of the chest and gout are more common in the north.

Europe considered as a whole, is situated between 35 and 71° north latitude; a small part only belongs to the Arctic zone; the rest is situated in the temperate zone, which, if divided in two, taking the 45° north latitude as the line of demarcation, will place by far the greater part in the colder temperate zone. Europe is situated between 6° west latitude, (or if Iceland be excluded, 7° 30′,) and 75° east of Ferro.

On east, Europe is thoroughly connected with Asia, and the transition is imperceptible. On this, the eastern frontier appears an immense plain from the Polar Sea to the Black Sea; continuing towards west, but is cut into a cuneiform shape by the Scandinavian mountains on one side, and Balkan, the Karpathians, Sudetes, Erzgebirge and the Harz mountains on the other side, and in this basin the Baltic is confined. West of the Harz mountains, the plain expands between the Atlantic on one side; the Weser, and the French mountains on the other. In this basin we might fancy the North Sea to be enclosed, the north-western brim of which in that case would be the British mountains. From this mode of view there would appear one large plain, divided into two minor ones, however, of unequal magnitude, by the Danish peninsula. From this enormous plain access to the Highland is opened first by the Hungarian plain, and the communicating deeply entering Danube-valley; secondly, by the equally deeply entering Rhine-valley. Although the Central European mountain chains in the preceding have justly been separated from themselves and from the Alps, they might, in a more common point of view, be united to those, and viewed as one immense Highland, if looking upon the base, on which the smaller mountains rest, as low side-terraces shooting from the Alps, and thus we obtain a definite distinction between the Highland and Lowland of

Europe. It has also been already observed, that both the Apennines and the Dinaric Alps are in connection with the Alps, and they might therefore be taken in under the same extensive Highland. The Pyrenées, on the contrary, are separated from those, but communicate with the mountains of the Spanish peninsula.

Europe would thus consist of four principal parts:—

1.—The large *south-eastern Highland*, including the Alps, the central European mountains, the Apennines, the Dinaric Alps, Balkan, and the Greek mountains. This is also the loftiest.

2.—A smaller *north-western Highland*, consisting of the Scandinavian mountains, and to which might be included also the mountains of Great Britain.

3.—A smaller *south-western Highland*, including the Pyrenées and the Spanish mountains.

4.—A large plain between these three Highlands, the Ural mountains, and the Atlantic Ocean.

The mountains of Crimea are isolated from the others; they are of small extent, and belong perhaps to Caucasus; also Iceland and some smaller islands come not within this division.

If all these mountains be classified according to their extent, the following classes might be established:—

1*st Class.*—The Scandinavian mountains, the Alps, Apennines, Karpathians.

2*nd Class.*—Balkan, the Dinaric Alps, the Greek and Icelandic mountains, (if they be admitted,) the Pyrenées, the Gallacian-Asturic mountains, Gaudarama, Serra Nevada, the Cevennes, Jura, the Scotch mountains, Serra Guadaloupe, Serra Morena, the Vosges, and the mountains of Sicily.

3*rd Class.*—The mountains of England, Sardinia, Auvergne, Böhmerwald, the mountains of Corsica, Schwarzwald, Rauhe Alps, the mountains of Crimea, Serra Monchique, the Sudetes, the mountains of Ireland, and the Fär-islands.

4th Class.—The Harz, Erzgebirge, and the rest of the smaller mountains in central Germany.

If these mountains be classified according to their highest summits we shall have—

1st Class.—Mountains reaching nearly 15,786* feet, the Alps.

2nd Class.—Mountains from 10,760 to 11,733 feet, Serra Nevada, the Pyrenées, and Etna.

3rd Class.—Mountains between 8,533 and 10,000 feet, the Apennines, the mountains of Corsica, and probably Balkan.

4th Class.—Mountains between 6,400 and 8,533 feet, Guadarama, the Scandinavian mountains, the Greek mountains, the Dinaric Alps, the mountains of Sicily, (Etna however excepted,) and Iceland.

5th Class.—Mountains between 4,270 and 6,400 feet, the Cevennes, the mountains of Auvergne, and Sardinia, Jura, the Sudetes, the mountains of Majorca, Crimea, Schwarzwald, the mountains of Minorca, the Vosges, and the Scotch mountains.

6th Class.—Mountains below 4,270 feet, all the rest whose height has been ascertained.

This order would be somewhat changed, if the mean height of the mountains was laid down as the standard, which does not always correspond to the height of the summits.

With regard to the direction of the larger *elongated mountain* chains, we find—

In East and West.—The Alps, Balkan, the Pyrenées, the Spanish chains.

In North and South.—The Scandinavian mountains, the Cevennes, Vosges, Schwarzwald, the mountains of Sardinia and Corsica.

* The heights were given originally in Paris feet, we are responsible for their reduction throughout this paper to English feet.—*Editor Calcutta Journal Natural History.*

In North-west and South-east.—The Apennines, the Dinaric Alps, the Sudetes, and Böhmerwald.

In South-west and North-east.—Jura with Rauhe-Alpadn, the Scotch mountains.

Of a *rounded* form—The mountains of Auvergne, Harz, and some smaller ones.

Mountain groups from the mountains of Greece, Iceland, Sicily and Ireland, with those situated on the arched mound of the Karpathians.

Isolated mountains of considerable height, on the plains, are Etna, Hecla, Montserrat, Vesuvius, Gargan.

Of the plains, the east European is the largest, next to which the north European, then the Hungarian, after which follow the rest. Of the table-lands, the Spanish is the highest and most extensive, next to which the Bavarian.

Were the Rivers of Europe to be classified according to their respective length, they would follow thus :—

1*st Class.*—Volga and Danube.

2*nd Class.*—Dniper and Don.

3*rd Class.*—Rhine, Petschora, Dwina, Vistula, Dniester, Elbe, Loire, Tajo, Düna, Guadiana, Oder, Niemen, Duoro, Ebro, Po, Rhone, and Guadalquivir.

4*th Class.*—The rest of the rivers mentioned in the preceding.

The Caspian Sea receives the largest river ; the Black Sea the three next; of the 3rd class the Arctic Ocean receives two; the Baltic four; the North Sea two ; the Atlantic five; the Mediterranean three; the Black Sea one.

With regard to their sources, three of the two first classes originate on the east European plain : the Danube from the Alps, the central European mountains and Balkan. Of the 3rd class rivers, three come from the Alps, four from the central European mountains, five from the Spanish mountains and the Pyrenées, and five from the east European plain. From this will be seen, that the largest rivers originate on

the east European plain, and those next to them in the Alps.

The Scandinavian and the Greek Peninsula, and the European Islands possess no river sufficiently large to come under the three first classes.

It is already mentioned, that the north of Europe possesses more lakes than the south. The largest collection of lakes forms a broad belt south-east of the Scandinavian mountains in the north of Russia, Finland, and south Sweden; another parallel belt of smaller lakes appears on the south side of the Baltic. A third considerable collection of lakes, is that at the foot of the Alps.

The conspectus of the temperature of Europe is rendered easy by drawing lines, (isothermic lines,) through all such places which have an equal annual mean temperature. The considerable southern curvature of those lines in the east of Europe, proves that the heat decreases towards the east. Thus the isothermic line for 4° Reaumur falls a little south of Iceland, in the 63° north latitude, a little south of Drontheim in nearly the same latitude, but at the Baltic it sinks down to the 60° north latitude, and in Russia to 55°. These curvatures are larger in the north, than in the south of Europe.

It has already been observed, that the quantity of rain particularly depends upon the mountains, and the vicinity of the sea, and that the south and the south-west side of the south European mountains are the most rainy localities.

Perpetual snow appears in Iceland, Scandinavia, Balkan, the Alps, Pyrenées, and Serra Nevada. The summits of the Karpathians, Apennines, of Etna, and the Corsican mountains touch the snow limit. At the North Cape this line is 2,346 feet above the level of the sea, on Etna 11,182 feet. It sinks everywhere somewhat towards the sea. Avalanches (*Glaciers*, 'Gletschen',) appear in Iceland, Scandinavia, and the Alps, and faint traces in the Pyrenées and Karpathians.

As the sky is clearer in the south than in the north, so it is also clearer in the east than in the west, where the vapours of the sea frequently produce fogs and clouds.

The north limits of some of the most common trees form lines that bend to the southward in the western part of the north of Europe, thus indicating the vicinity of the sea being unfavourable to forest vegetation. The different trees, however, offer remarkable modifications in the latter respect. The north limit of the beech is much curved towards the south in the eastern part of Europe.

The northern limits of the most important cultivated plants are explained by the lines which also serve to explain how corn and vine cultivation depend upon the mean temperature of the summer, while that of the olives and oranges upon the mean tempeature of the winter.*

Taking into consideration the wild plants as well as the cultivated, Europe might be divided into the four following zones, provided all the mountains, the lower temperature of which of course change matters, be excepted:—

1.—*Northern Zone. The Zone of the fir and birch. The uncultivated Zone.* Here are either no forests at all, or birch and pine forests; some mountains; plants, none; or very little grain cultivation, (barley,) no fruit tree. The occupations followed here, are fishery and breeding of cattle. Iceland, Fär-islands, Scandinavia north of 64°, Russia north of 62°. Most of these regions are mountainous.

2.—*First intermediate Zone. Zone of the beech and oak. Zone of the grain.* Forest partly of pines,† partly of beech and oak, some heaths with heather; much grain, particularly rye; northern fruit trees; considerable breeding of cattle. The British isles, Scandinavia south of 64°, Finland,

* The isothermal lines and the limits of several kinds of vegetation and cultivation are laid down in Professor Schouw's original sketch in various Maps, &c., which we are unable to introduce here.—Ed.

† Original "Needle Trees," which are probably *Pines.*—Ed.

the east European plain between 62° and 48° north latitude, the north European plain, and Denmark, mostly plains.

3.—*Second intermediate Zone. Zone of the chestnut and oak. Zone of the vine.* Forests of leaf-trees, principally chestnut, oak and beech. (Pines on the mountains;) grain, particularly wheat, also maize and vine. All the plains and valleys between and on the central European mountains, and the east European plain south of 48°.

4.—*Southern Zone. Evergreen Zone. Olive Zone.* Evergreens, wheat, maize, rice, vine, olives, southern fruits. In the southern part, oranges. The three south-European peninsulas. To these four zones, situated north and south of each other, correspond tolerably well those mentioned under the head of Italy, forming four principal zones of altitude; viz.—1. The evergreen zone, or the olive zone. 2. Chestnut and oak, or vine zone. 3. Beech and grain zone. 4. Mountain plant zone, or the uncultivated zone. The zone of fir and birch is missing, but it exists as a regular zone on the Alps.

From the chief occupations of the nations, the following geographical divisions might be established:—

Fishery, chiefly in the northern part of Scandinavia, Iceland, the Fär-islands, north of Scotland.

Breeding of sheep, particularly on the Spanish table-land, the mountains and plains of Greece, Puglia, Iceland, and the Fär-islands.

Breeding of horned cattle in the western part of the north-European plain, the British Isles, and on the Alps.

Cutting of wood on the Scandinavian peninsula, the northern part of the east-European plain, the eastern part of the north-European plain, on the Alps, and the central European mountains.

Cultivation of grain on the extensive east-European, and the north-European plain.

Cultivation of the vine in the south-European peninsulas

and in the valleys between the central European mountains.

Cultivation of olives and southern fruits in the lower valleys of the south-European peninsulas.

Mining in the Scandinavian, Scotch, English mountains, the Harz, Eryzebirge, the Alps, Pyrenées, the Gallician mountains, Serra Morena, and the Hungarian mountains.

Land-trade, chiefly on the east and north-European plains.

Sea-trade in the west and south of Europe.

Manufactures, more extensive in the west (England, Belgium, France, north Germany,) than in the east; more so in the north than in the south. *Navigation* also is more important in the north than in the south.

List of the Heights quoted.

Names.	Paris. feet.	English feet.	Remarks.
Gousta, ...	5801	6150	Smith. Topogr. Stat. Saml. 2. D. 2 B.
Justedelsbrä, ..	6000	6400	v. Buch. Gilb. An. 41.
Skagestoltind, ..	7650	8160	Keilhau and Boeck, Mag. for Naturvid. 1.
Lodalskaabe, ..	6190	6602	Bohr. Morgenblad 1822, No. 155.
Sneehätten, ..	7099	7572	Hisinger, Antekn. 3.
Syltop, ...	5507	5874	Do. do. 2. 3.
Sulitelma,.. ..	5796	6182	Wahlenberg, Mättn.
Enontekis,.. ..	1341	1430	Grape. (Ehrenheim. Klim. Rörligh.)
Taberg, ...	1032	1100	Hisinger, Profiler.
Kinnekulle, ..	856	913	Do. do.
Rytterknägten, ..	480	512	Orsted og Esmark, Bornholm.
Finland, (greatest height) ..	1200	1280	Engelhardt. Darst. 1.
Oräfa Jökul, ..	6030	6432	Scheel MSS.
Oster Jökul, ..	5340	5696	Ohlsen, (Scheel MSS.)
Hekla, ...	5033	5368	Soekort Arkiv. Kort.
Slattaretind, ..	2712	2892	Forchammer MSS.
Skiellingfield, .	2347	..	Do. Do.
Ben Wywis, .. } Ben Newis, .. }	4110	3722	Boué, Essai Géologique.

Names.	Paris feet.	English feet.	Remarks.
Cairngorm, ...	„	4083	Boué, Essai Géologique.
Hartfell, ...	3096	3376	Do. do. do.
Hellvelyn, ...	„	3227	Dalton, (Brewster's, Cyclop.)
Skiddaw, ...	2835	3024	Conybeare and Philips' Outl. of Geol.
Snowdon, ...	3377	3602	Brewster's Cyclop.
Dortmoor, ..	1681	1793	Conybeare and Philips', l. c.
McGillicuddy's Rocks, ...	3193	3331	Miltenberg.
Nephin, ...	2468	3632	Kirwan, (Brewster Cyclop.)
Montagnes d'Arrée,	942	1004	Berghaus' Map.
Côte d'Or, ...	1716	1830	Do. do.
Plateau de Langres,	1584	1689	Do. do.
Himmelbjerg, ..	510	544	Schouw MSS.
Aborrebjerg, ..	476	507	Schouw, (Paludans Moen.)
Veirhöi, ...	371	395	Wessel and Schouw MSS.
Stubbenkammer, ..	540	576	Brugiere Orographic.
Golmberg, ...	555	592	Mädler (Berghaus Ann. 1.)
Duberowberg, ..	443	472	Klöden (ibidem).
Hasenberg, ...	594	643	Ibidem, 2.
Mont d'Or, ..	5814	6201	Berghaus' Map.
Cantal, ...	5718	6099	Delambre, ibid.
Pierre sur Haut, ..	5964	6361	Ibid.
Mt. Mezin, ..	5322	5676	Ibid.
Lozère, ...	5280	5632	Hombre Firmas, (Bibl. Univ. 1832.)
Pré de Marmiers, ..	5300	5653	v. Malten (Berghaus, Hertha 13)
Réculet, ...	5280	5632	Do. do. do.
Mont Tendre, ..	5180	5525	Do. do. do.
Dôle, ...	5160	5504	Do. do. do.
Hohenberg, ..	3160	3370	Oyenhausen, Hertha 1.
Ballon de Sulz, ..	4337	4626	Miltenberg, (mean height out of four measurements.)
Ballon d'Alsace, ..	3870	4128	Andre de Gy. (Miltenberg.)
Feldberg, ...	4500	4800	Miltenberg, (mean.)
Malchen, ...	1573	1677	Oyenhausen and Dechen Map.
Brocken, ...	3506	3739	F. Hofmann, (Berghaus Ann. 1.)
Weser Mount, ..	1441	1537	Do. do. do.
Grosser Beerbery,	3150	3329	Berghaus, Erdbeschreib.
Schneeberg, (Fichtelgebirge,) ..	3221	3435	Bürg, Hofmann, Weiss, (Bergh. Ann. 4,)
Schwarzwald, ..	3769	4020	Hallaschka, (ibid.)
Heidelberg, ..	3860	4117	Miltenberg.
Arber, ...	3840	4096	Hoser, (Miltenberg.)

Names.	Paris feet.	English feet.	Remarks.
Schneekoppe, ..	4946	5275	Hallaschka, (Bergh. Ann. 2.)
Glatzer Schneeberg,	4300	4586	Charpentier, (Miltenberg.)
Eisthalerspitze ..	8000	8533	Wahlenberg, Flora Carp.
Lomnitzerspitze, ..	7944	8473	Do. do. do.
Hundsdorfferspitze,	7800	8320	Do. do. do.
Clermont, ...	1265	1349	Ramond, Mem. sur la form. bar.
Gaisekaln, ...	965	1029	Struve, (Bergh. Ann. 12.)
Tschadyrdagh, ..	4742	5058	Engelhard and Parrot, Reise.
Babugan Jaila, ..	4724	5038	Do. do. do.
Orbelos, ...	9000	9600	Poqueville, (Miltenberg).
Mt. Dinario, ..	7000	7466	Hacquet, (Miltenberg).
Klek, ...	6500	6933	Do. do
Mt. Viso, ...	11809	12596	Corabauf, (Mem. de la. Soc. de Geogr. 2.)
Loucyra, ...	13548	14451	Guérin (Miltenberg.)
Montblanc, ..	14798	15786	Roger, (Bibl. Univ. 1828.)
Mt. Rosa, ...	14273	15224	Coraboeuf, (l. c.)
Jungfrau, ..	12872	13730	Tralles. Best. der Höhen.
Finsteraarhorn, ..	13234	14116	Do. do. do.
Ortler, ...	12059	12863	v. Welden, Monte Rosa.
Groszglockner, ..	12483	13315	Schiegg. (v. Welden) v. Moll Jahrbüch, 1800 Mean.
Terglou, ...	9294	9913	Hacquet, (Miltenberg.)
Steiner Alp, ..	10274	10958	Valsoret, (Miltenberg.)
Col de Tende, ..	5739	6121	Schouw MSS.
Col de Genévre, ..	6109	6516	Hericart. Villars. (Journ. de Phys.) Mean.
Mt. Cenis, ...	6446	6876	Schouw, (Zach. Corresp. 1.)
Gr. Bernard, ..	7668	8179	Biblioth. Univ.
Simplon, ...	6198	6611	Hertha, 1.
St. Gothard, ..	6439	6868	Schou Witterungskunde.
Splügen, ...	6451	6881	Schouw, (Zacch. Corresp. 1.)
Stilfser Joch, ..	8610	9184	v. Welden, Mte. Rosa.
Brenner, ...	4364	4654	v. Buch. Geog. Beob.
Semmering, ..	3122	3330	Fallon. (Zacch. Monatl. Corr. 25.)
Lake of Geneva, ..	1146	1222	Roger. Bibl. Univ. 1828.
Lake of Neufchatel,	1340	1429	Malten, Hertha 14.
Lake of Zürich, ..	1264	1348	Wahlenberg, Tentamen Helvet.
Lake of Boden, ..	1089	1161	Miltenberg.
Lake Cenis ..	6070	6474	Schouw (Zach. l. c.)
Milano, ...	420	448	Cesaris. Bibl. Ital. 1831. Feb.
Ofen, ...	477	508	Wahlenberg Flor. Carpath.
Geneve, ...	1200	1280	Bibl. Univ.

Names.	Paris feet.	English feet.	Remarks.
Münich, ...	1629	1737	Schöu. Witterungsk.
Peissenberg, ..	3088	3293	Do. do.
Vignemale, ..	10326	11014	Reboul. and Vidal. Ann. de Chim. T. 5.
Mt. Perdu, ..	10482	11180	Do. do. do.
Pic Posets, ..	10584	11289	Do. do. do.
Pic Nethon, ..	10722	11436	Do. do. do.
Mont Calm, ..	10008	10675	Do. do. do.
Canigon, ...	8580	9152	Do. do. do.
Mt. Louis, ..	4890	5216	Cotte Memoir, T. 2.
Madrid, ...	2016	2150	Bauza & Humboldt, (Hertha 4.)
Granada, ...	2414	2574	Rodrigues, (Ann. de Chim. 1822.)
Penalura, ...	7716	8230	Bauza, (Humboldt, l. c.)
San Ildefonso, ..	3846	4102	Do. do. do.
Pass of Guadarama,	4818	5139	Humboldt, l. c.
Cerre de Mulhacen,	10870	11594	Rodrigues, l. c.
Albujarras, ..	8700	9280	Miltenberg.
Serra Foja, ..	3830	4085	Franzini, (Balbi Essai Statistique.)
Silla Torellos, ..	4802	5122	Miltenberg.
Mte. Toro, ...	4500	4800	Brúgiere Orographie.
Mte. Cimone, ..	6645	7088	Inghirami, Elevazione delle princip. eminenze della Toscana.
Alpe di Camporaghene, ...	6153	6563	Ibid.
Sibilla, ...	6766	7217	Schouw, (Zach. Corr. 2.)
Gransasso d'Italia,	8935	9530	Do. do. do.
Majella, ...	8770	9354	Do. do. do.
Mte. Pollino, ..	7004	7470	Schouw MSS.
La Sila, ...	5000	5333	Schouw, (approx.)
Aspromonte, ..	6000	6400	Do. do.
Pizzo d'Uccella, ..	5771	6155	Inghirami, l. c.
M. Amiata, ..	5436	5798	Schouw, (Zach. Corresp. Astr. 1.)
Schiena d'Asino, ..	4547	4768	Prony. Marais Pontins.
Mte. Albano, ..	2966	3163	Schouw, (Zach. Corresp. Astr. 1.)
Gargano, ...	3000	3200	Schouw, (approx.)
Vesuvius, ...	3774	4025	Humboldt. (Hertha 12.)
Euganeans, ..	1830	1952	Shouw MSS.
Elba, ...	3097	3303	Piquet. Carte de l'isle d'Elbe.
Stromboli, ..	2037	2172	Smyth, (Zach. Corr. 10.)
Pass of La Bocchetta, ...	2367	2524	Schouw, (Zach. Corr. Astr. 1.)

Names.	Paris feet.	English feet.	Remarks.
Pietramala, ...	2996	3195	Schouw. (Zach. Corr. Astr. 1.)
Ariano, ...	2352	2588	Do. do.
Lago Fucino, ..	2047	2183	Schouw, (Zach. Corr. Astr. 2.)
Le Madonie, ..	6111	6518	l. c. Do. do.
Enat, ...	10484	11182	Schouw, Bibl. Univ. 1819.
Genargentu, ..	5632	6007	Marmora Sardaigne.
Mte. Rotondo, ..	8506	9073	Annuaire de la Corse.
Mte. d'Oro, ..	8166	8710	Perney, (Miltenberg.)
Pindus, ...	6500	6933	Holland, Travel.
Taygetus,.. ..	7441	7937	French Engineers, (Berghaus.)
Ida, ...	7200	7680	Sieber, Reise nach Kreta, 2.

Concluding Observations of M. DESHAYES, *on the completion of his great work on the Fossil Shells of the Paris Basin.**

Having concluded the description of the fossil shells of the environs of Paris, it will not be altogether useless to take a rapid view of the general results obtained by their study.

All those persons who are now occupied in geological researches, acknowledge how much useful aid they have obtained from a knowledge of organic fossil bodies, which are imbedded in the crust of the earth. We have already said, that they are the authentic medallions by which we are enabled to trace the philosophic history of the successive revolutions to which the planet we inhabit has been subject.

Great results have already been accomplished in the science of geology, and much grace has been conferred on its study by combining it with that of fossils; and these results are almost always obtained by means of appropriate inductions derived from a comparison of the organization of living animals with the remains of the extinct, or fossil species. There can be no doubt geology, although still

* "Description des Coquilles Fossils des environs de Paris, par G. P. Deshayes," &c., *tome second, p.* 763.—ED.

in its infancy, is far from an art of minor perfection; nor is it confined to enquiries merely of more or less exactitude into the chronology of the ages of our earth, but it also attempts to revive, as it were, the forms that peopled the surface of the earth at times anterior to the existence of man, and of which it is impossible to have any other history than the primitive ages have left us in these ancient medals. It is not alone to determine the periods of mineral changes, which are uncertain in their nature, and of comparatively little philosophical importance; but it is the glory of the geologist, aided by the labours of zoologists and botanists, to collect and arrange materials for the history of each of the great periods during which organic beings were successively developed, and to bring them by a succession of great events, (sometimes interrupted,) down to the period of authentic history.

Cuvier in his *Recherches sur les Ossemens Fossiles*, and M. Brongiart in the example of the great zoologist, have been the first to introduce the study of organic fossils, and Cuvier in particular has afforded, by numerous examples and happy inductions, various beautiful applications of this study to geological pursuits. M. Brongiart afterwards conferred additional value on the study of organic fossils, by extending their application to geological questions, which appeared to him to have remained before without satisfactory solution, and which were capable of illustration by means of those particular organic fossils which formed the peculiar subject of his own study. It is no easy matter indeed to seize for sound geological application, such parts of the science of fossils as are most adapted to the purpose. All branches of the subject are doubtless useful, but all are not so to the same degree; thus for example, the remains of vertebrated animals are rare, and difficultly determined, diminishing rapidly in proportion as we descend, seldom affording results so general as those of other classes. Thus it must also follow

from the circumstance of plants being extremely favourable to their preservation, that numerous terrestrial strata will contain some traces of them.

This is no less the case with many classes of invertebrate animals, and among these, shells and zoophytes are the most universally distributed. These bodies are seen in all strata; frequently distributed in great abundance; and their study well attended to, is an immense aid; for they cannot be examined with a view to the great question of their history, without affording exact materials for the solution of the difficult question of the general and physical history of the globe.

To render useful services to the science of geology, it is necessary that zoologists should apply themselves to the minute study of those fossil bodies, which are most universally distributed.

In this point of view, Conchology possesses an incontestable pre-eminence; but it is unnecessary to defend a science, which from the taste and zeal of its amateurs, has recently become a fashionable study, more difficult however than is generally supposed, and only conferring utility in its vast applications in proportion as we descend to its minutest details.

This science, like all the other branches of Zoology, implies an acquaintance with the intimate structure of animals, so as to combine the character and affinities of organization with the form of the solid body which the animal supports. It is after we have become acquainted with all the facts detailed relative to living mollusca, that we can arrive at a rational knowledge of fossil shells by means of inductions sometimes difficult, in which we are guided nevertheless by recent shells.

The inductions are first applied to the fossil species which approach nearest to the living; but in proportion as we descend in the strata of the earth, the species differ more and

more from our own, belonging frequently to extinct races of animals; and it is necessary to be able to employ these inductions, so as to verify each step by observation. Thus for example, after obtaining the first results of comparison between the fossil and living species, the former must then be compared with the fossils of different types, and on this process being extended to the whole series of fossil shells, our judgment is to be formed from the result. It is by following those steps of which we are now about to afford a rapid view, and which we have endeavoured to detail at large in this work, that we may hope to facilitate a knowledge of the geology of a set of strata, which will serve as a starting point in the study of tertiary rocks, and at the same time present to the zoologist interesting facts relative to species which no longer exist on the surface of the earth.

From the study of our species of the Paris basin being nearly complete, they afford the hope, after very extensive researches on the subject, that we shall be able to deduce from them a standard of comparison for the study of other tertiary beds in which the same fossils occur.

In a work presented to the Academy of Sciences in 1831, we have given the results of the comparisons which we had made between the shells of living species and the fossil shells of the tertiary deposits of Europe. One of the principal results of this comparison has been the determination of the peculiar characters of these beds, and an indication of their superposition; these results with prophetic spirit appear to have anticipated subsequent acquisitions which have been made to science by the researches of geologists, and it is thus that we have also realised our former conjectures, and have established the importance in these pursuits, of inductions derived from zoological inquiries.

Another result obtained by the same means is, that no one species of shell has been found to belong to both secondary and tertiary strata: thus the upper beds of the

secondary, which constitute the chalk formation, are perfectly distinguished from the tertiary strata by means of geological observations, as they are by those of the zoologist. Objections have been made to this result, founded on the existence of beds in which there is an intermixture of species of the chalk with those of tertiary fossils. But we are convinced that this is an error, arising from incomplete observations, and we doubt not, will so appear when these same beds shall have been examined by competent persons without regard to theoretical opinions. Every where in short, not alone in the Pyrenèes, geologists agree in the obvious distinctions between the chalk formation and the tertiary beds.

The Paris basin, placed in a geological series between the chalk and the upper tertiary beds, presents to the researches of the learned a deep interest, from the hope of its affording a solution to questions of great importance. It was natural at first, to compare the species which these more ancient deposits afford with those which are now alive.

But if it be true, as we believe, that the whole of the species of the secondary beds have been destroyed in Europe, at least before the establishment in the same countries of those of the tertiary, we must conceive the chain of succession to have been violently broken, from whatever cause is difficult of explanation. If after a great cataclysm, all the races of marine animals were to be destroyed, how are we to explain the sudden reappearance of the whole of the zoology of the Paris basin, which we have proved to consist of nearly 1200 species, belonging alone to the class of molluscs? These have been well examined in a succession of species and individuals, in order to establish their modifications, and define the limits of the species; but that which we have been unable to comprehend, and which is yet *inexplicable to us in the present state of our* knowledge, is the extinctions and remodelments of races of animals which have frequently taken place during long geo-

logical periods, such as those which we know to have happened in Europe.

The comparison of the species of tertiary beds with those of the secondary, of which we have just now spoken, having afforded the important result that none of the species of the secondary deposits lived at the same time with those of the most inferior tertiary beds, it was curious to examine whether these inferior tertiary beds contained any species which might be identified with those which now live. This identity is incontestably established, but only in regard to a small number of species, which is sufficient, we think, to connect the tertiary epoch with the present, and this connexion is so much more remarkable, as we have seen the number of analogues augment in proportion as we pass from the more ancient to the more recent beds.

Yet within these few years geologists assimilate the whole of these beds, which they believe to be of the same age, and represent them parallel, bed for bed, to those of the Paris basin. But we have seen in the tertiary beds not a parallelism, but a true succession, and at the same time we have made use of the analogy of fossil species to distinguish between them, where they are limited to a very small number of those tertiary basins of the same geological epoch with that of Paris. We have had occasion in the course of this work in giving the localities of the species, to mention two of these tertiary basins which are of the same age with ours; we refer to that of London, and to that of Belgium, as more extensive and considerable than we are in the habit of supposing.

The little tertiary basin of *La Manche*, in the environs of *Volognes;* the calcareous beds of *Bas-medoc*, which are deposited below, and on either side of the vast basin of *Gironde;* on one part of the valley of *Ronca*, near Verona; the limestones of *Castel-Comberts;* the beds singularly modified in the Alps, and which are met with particularly in

the *environs* of *Gap;* belong also to the formations of the Paris basin, because they contain the same fossils. It appears, indeed, that the same fossils are presented again in Hungary and in Moldavia, which announces that the sea from which they have been deposited, was vast and extensive. We may remark, from the observations of others, that traces of the presence of the same sea will be found far more extensive than those we have mentioned. A very important question suggests itself here, as depending on a more careful examination of fossil species; many persons for instance, have been employed in researches relative to the temperature of the earth during the great geological epochs. To arrive at the solution of this question, numerous important things require to be considered, and whatever light we are to hope for on the subject, we believe must result from an investigation of the tertiary beds of Europe, among which those of the Paris basin occupy a principal place; for the question of temperature is inseparably connected with the character of the animals, whose remains are entombed in these strata. And here we have to encounter the only source of difficulty; but when the whole of the phenomena connected with the tertiary strata are examined together, they lend a mutual support to the results. We are now accordingly to afford a brief statement of our opinions on the subject, and of the means by which we have formed our conclusions.

If the character of the plants, as learnedly established by M. Arago, in *L'Anuaire du Bureau des Longitudes de* 1834, enable us to afford an approximation to the mean temperature of periods in which they lived; if the existence in certain places of the vine, palms, &c. be equivalent with the philosopher to thermometric observations, we thus know that the animals, and above all, those which people the waters of the sea, enable us by their presence to determine very nearly the mean temperature of the places they inhabit.

All marine animals are not true indicators of temperature; it is necessary to select for the purpose, those whose feeble movements constrain them to depend for their sustenance on the alternations of the seasons, and compel them to limit their influence to the places where they were first produced. The greater number of the mollusca and zoophytes supply these conditions.

To arrive at the knowledge of the temperature of the times anterior to the existence of man, the logical course to pursue is, first, to search for some positive position to start from, so as to assure ourselves of the real character of the animals from which we derive our evidence, and then to seize upon those conditions of their existence, with which temperature has more or less to do. It is the principal part which temperature plays in the distribution of the mollusca, in advancing to the North or South, which we are now briefly to explain; and for brevity's sake, shall speak only of those which have been collected near Cape North, and in the Gulf of Guinea.

If the small number of species which live in the north be separately considered, they can be divided into two very distinct kinds: the one proper to the colder seas, do not pass beyond the limits of these; the others, in smaller number, coming to live in the temperate regions of Germany, France, and England, with the species of these seas.

In examining the testaceous molluscs of the seas of the temperate regions of Europe in which there exists a greater number of species than in the seas of the north, it is easy to separate them into three series: in the first of these are comprised those which we have indicated, and which return again to the seas of the north; the species of the second series descend into the seas of the south; lastly, those of the third series are proper to European temperatures. If we now carry our observations to the

intertropical regions, we meet with similar phenomena; we meet with a greater number of species than in the two preceding regions, and amidst these, some are proper to the temperate region; a great number also proper to the equatorial seas.

These are general facts, and we can already draw from them this general conclusion, that each assemblage of species represents the mean temperature. But there are some species more locally, and others more generally distributed. Thus the *Buccinum undatum,* for example, is found from Cape North to Senegal, slightly modified by temperature; thus it is easy enough to distinguish in it the varieties produced by three or four principal conditions of temperature. This species is not the only one thus distributed, but we are already acquainted with a very considerable number, having with this the property of living in different temperatures.

Other species more sensible of the influences of temperatures, are much more local, and are those which it is important to understand. I here enumerate some of them :—

1. *Buccinum glaciale.* It does not extend beyond the polar circle, and is found in Norway and Greenland.

2. *Cardium grœnlandicum.* With the preceding.

3. *Terebratula psittacia.* Between 65° and the 75°; these species, and many others which it would be too numerous to mention, represent the mean temperature of the north of Norway.

1. *Tellina baltica.*
2. *Patella noachina.*
3. *Natica clausa.*
4. Many species of the genus *Astarte.*
5. *Patella testudinalis,* etc.

These and other species represent the mean temperature of the north of England, south of Sweden and of Denmark. In the British Channel, on the coasts of France and England, there also exist many species peculiar to our temperature.

1. *Pholas callosa.*
2. *Psamobia vespertina.*
3. *Pecten irregularis*, etc.

The coasts of Spain and Portugal are less known than those of New Holland or South America.

The Mediterranean contains also a great number of species peculiar to it; but as this is an inland sea, we will not now speak of it, lest we should attribute the presence of its species to peculiar circumstances.

The observations are few in number on the coasts of Africa, from Barbary to Senegal; but for this important region, we have the excellent work of Adanson, and the commercial relations with Senegal and Guinea have long since enriched the collections of marine shells from this quarter.

Amidst the great number of species known in the intertropical zone, there are many which are peculiar to it, but the list is too long to enter into the particulars in this place. The species inhabiting warm climates are less variable, nor are they met with living on any other part of the surface of the globe; they determine therefore with fidelity the temperature of the sea they inhabit.

These facts are mentioned as concisely as possible, that they may precede what we have to say on the temperature of the geological epochs of the tertiary strata; but to afford a solution of this interesting question, it was necessary that the whole of the living species with which we are acquainted, should be compared with patience, care, and minuteness, with all those that are found in the different tertiary beds of Europe; and here are the principal results obtained by our labours on this subject:—

1. The tertiary beds of Europe do not contain any one species identical with those of the secondary rocks.
2. The tertiary beds alone contain species still living.
3. The analogues of living species are more numerous in proportion as the bed is more recent, and vice versa.

4. The constant proportions (3 per cent. 19 per cent. and 52 per cent.) in the number of living species determine the age of the tertiary beds.

5. The tertiary beds are in superposition, and not in parallellism as had been supposed.

6. The beds, from their zoological contents, appear to be divided into three groups or stages.

About the month of August 1831, we proved the existence of these groups, and indicated the places where the observations were made; geologists have since confirmed these results, and separated the tertiary rocks accordingly.

The latest and most superficial tertiary strata have been deposited when the temperature of Europe was almost the same as it is at present; here are the proofs.

The tertiary beds of this age, of Norway and Sweden, of Denmark, of Saint Hospice near Nice, of a portion of Sicily, contain in a fossil state, all the species of the corresponding seas, and amongst others, those which in most places best represent for us the temperature. These fossils present the same series of varieties with the living species which announces most positively, that the beds referred to have been deposited under circumstances similar to those in which their existence is still maintained. These same beds in the South of France, subject to the Mediterranean, of Spain, of Italy, and of Sicily, of the Morea, of Barbary, (Algiers,) contain a large proportion of the species still living in the Mediterranean, but they contain also those whose analogues do not exist, or are distributed in small numbers in the warmer regions of the Atlantic, and the Seas of India. To afford a correct idea of the tertiary period in Italy, we must distinguish three sorts of fossil species.

1. Those whose analogues are still living in the Mediterranean.

2. Those in small number, whose analogues are not found

in the Mediterranean, but in the Atlantic Ocean, the Red Sea, and the Seas of India.

3. Those of which no living analogues exist.

These observations we have made, thinking that the Mediterranean had been selected for trial on an insufficient basis on account of the chain of the Atlas mountains on one coast, and that of the Apennine on the other, affecting the temperature. These changes in the elevation of strata, and consequently of temperature, explain the extinction of the living analogues of a certain number of fossil species on the sides of the Mediterranean, and the distribution of certain others in warmer seas. To us it appears probable, that the Mediterranean before the last movements of its borders, had one large open communication with the Atlantic Ocean through the great desert of Africa, and another with the Indian Ocean, which may have been either by the Red Sea, or by the flat sandy parts of Arabia, which separate the Mediterranean from the Persian Gulph.

The second tertiary period composes a great number of little basins; as the *Superga*, near Turin; the basin of the Gironde; the marine deposits composing the *faluns* of Touraine; the little basin of Angers; the basin of Vienna in Austria; the *Pódolia;* the *Volhinia;* and some other patches on the southern frontier of Russia in Europe; patches, whereof some spots are seen not far from Moscow. The lacustrine beds of *Mentz*, and the borders of the Rhine, also probably belong to this period.

The duration of this period we do not know, but it has been considerable, for not only have the deposits formerly composed a large surface, but they have still in many places a great thickness. During this period, the temperature has been very different from that which we now experience; indeed the species proper now-a-day to Senegal and the sea of Guinea, those which represent the mean tempera-

ture of the tropics, correspond with the fossils in the several places we have mentioned. Now, considering the number of species, and the great number of individuals belonging to each of these, their development would suggest the basin of the Gironde as the line of greatest intensity of heat, where in former times an equatorial temperature prevailed; it has necessarily been to this temperature that we owe the present fossil remains of species, which in former times inhabited our seas. It was necessary that this increased temperature should also have been directed continuously during a long series of cycle, in order that the accumulated constituents of generations should form by their remains a solid of such vast expanse.

If, as we firmly believe, the basin of Gironde to have been deposited under an equatorial temperature, it will be sufficient to cast a look at a map in order to feel convinced that the influence of this temperature has extended as far as Poland, and to the middle of Russia in Europe.

To determine the equatorial temperature of our second tertiary period, we have compared nearly two hundred species of the intertropical zone with the fossil species from the upper strata at Bourdeaux and Dax, and other basins belonging to this second period; but unfortunately one conclusive element is deficient for the first tertiary period, that which represents the Paris basin. In nearly fourteen hundred species, thirty-eight only have living analogues; it is true that the greater number of these species are found throughout the equatorial zone, but among them there appear to be some, which are found not only in that zone, but which pass into our temperate seas, and even wander to the North Sea.

I must therefore abandon, in regard to the most important tertiary period, those means for the estimation of its temperature, which have been employed with success in the case of the two preceding periods. We endeavour in the mean

time to supply by several indirect means, the want of direct means of comparison which we here experience.

In the frozen seas, there exists but a small number of molluscs; but some species are adapted to endure cold in proportion as they advance from the warmer regions, and thus there are but eight or ten, which subsist at the 80th degree, while there are above nine hundred living species in the tropical region of Senegal and Guinea. This augmentation of species with temperature, sufficiently indicates the powerful agency of heat in the creation of these beings. But this phenomenon is not alone seen in those parts of the terrestrial globe which we have selected for example, it is repeated from the sea of Behring to the isles of Sunda, and may be traced inversely on each coast of South America.

One important fact is elicited, and affords a new *point d' appui* in the estimation of the temperatures of these last tertiary periods; it is the proportion in the number of fossil and of the living species. Thus in northern latitudes, few species exist, and few of those which do, are found fossil; of tropical regions nearly seven hundred species are fossil, and six hundred exist. It must be remembered, that this difference in the proportion of the living as compared with the fossil species, is owing to a certain number belonging to lost races. In short, the elevated temperature of the second period may be regarded as settled with certainty, when we state, that nearly one thousand species in the corresponding basins have been examined and compared with nine hundred living species from the intertropical seas of Africa.

Since the number of species accords with the temperature; since, on one particular portion of the intertropical region, we find nearly nine hundred species, it appears to me natural, that we should attribute to the first tertiary period a temperature at least equatorial; for we are actually acquainted with fourteen hundred species, of which twelve hundred were collected in the Paris basin, that is to say, in

an extent of forty leagues in diameter in one direction and fifty-five in another, there do not exist in any of our seas any thing approaching to so many species in a space so limited.

If we now examine these species, we shall find particularly large numbers of them to belong to those genera and families, the species of which are so numerous in the warmest regions of the earth. One hundred and forty species of the genus *Cerithium*, a great number of the genus *Fussus*, of *Pleurotoma*, of *Mitra*, of *Voluta*, of *Venus*, of *Buccinum*, of *Arca*—fossils of the environs of Paris. The absence in this basin of the forms proper to the northern seas, all the considerations connected with Conchology, unite in attesting strongly the great period of time the Parisian strata required to form, under a temperature probably more elevated than that of the present equator.

In adverting to others parts of the Parisian Paleontology not belonging to Conchology, we find in the great number of *Pachydermata*, their size sometimes gigantic, a proof of the high temperature of the Paris basin. Where do we find in the present day analogous animals, if it be not in the tropical parts of Africa and South America, in the islands of Sunda, and in those of Asia? In addition to these considerations, those which are furnished by a small number of plants, particularly palms, sufficiently prove the high temperature of the period during which the first tertiary deposits took place. We might here be able to form a contrast between the ancient condition of the Paris basin compared with its present state—we might find on one side a great number of animals of which the races have become extinct; on the other, the soil occupied by the races of recent animals, and the seas in the vicinity peopled with species of which ninety-nine *per cent.* did not exist in former times. We should see in this comparison the proofs of the wonderful changes which are in operation in the conditions of the existence of living

beings; but we will not urge this interesting subject, which demands more attention than we could devote to it in this place.

The details we have gone over, appear to lead to the following conclusions:—

The first tertiary period must have rolled away under an equatorial temperature, in all probability, many degrees warmer than that of the present equator.

During the second period, the deposits of which occupy the centre of Europe, the temperature has been similar to that of Senegal and of Guinea.

The temperature of the third period was at first a little higher than that of the present basin of the Mediterranean, it then became, as we have endeavoured to shew, fixed or uniform: for in the north, the species of the north are fossil; in the south those of the south are fossil.

Thus we have established the fact, that since the commencement of the tertiary beds, the temperature has been constantly diminishing: the theory of the central heat of the globe, which rested on the supposition of philosophers, rendered the change of temperature, of which we have been speaking, probable; but it is curious to see a science long neglected approaching these important questions, and furnishing materials calculated to explain them.

The question of temperature is not the only domain of Zoology and Conchology in particular, its use extends to other subjects of no less importance, connected with the development of life on the surface of the earth, throughout time and space, in proportion to the extent of its materials; but this science is yet in its infancy. Lamarck has drawn the outline; who is to lay the foundation?

We have long since remarked, and we continue to repeat, that Geology had no claim to the character of an exact science until the moment when she adopted those branches of philosophy which treat of organic beings, their investiga-

tion from the nature of the subjects being more within a rational controul. It will now be understood, after what we have elsewhere said, that Zoology is the basis of Geology, and that there can be no science in the latter beyond what it owes to organic remains, and of this truth, we are therefore every day more and more convinced.*

The Silurian System. By R. I. Murchison, Esq., F.R.S., F.L.S., &c. &c. &c.

[Continued from vol. i. p. 527.]

We know of no elementary work in which the entire succession of strata, from the most ancient to the recent deposits are exhibited in a connected view, so as to include the results of recent observations. The rocks beneath the old red sandstone have been fully investigated by Mr. Murchison, who has pointed out a regular series of strata beneath the old red sandstone, distinguished by the

* Nothing can exemplify more forcibly the truth of the concluding observations of M. Deshayes, than the following analysis of Murchison's *Silurian System,* except indeed the original work of Mr. Murchison itself, which, like that of M. Deshayes, is unfortunately inaccessible, from its size and expense, to the generality of readers, particularly in India. Many instances of the practical importance of organic fossils in directing enquiries for coal and other useful minerals, will be found throughout our notices of Mr. Murchison's work ; but it is only necessary to refer the reader to vol. i. p. 18 of this Journal, to be convinced of the importance of fossil remains as the only sure guide in all enquiries connected with the subject of Geology, whether theoretical, or practical. The retrograde movement recently made in the Asiatic Society of Calcutta in the Patronage of '*Economic Geology*' is therefore much to be regretted, however we may be disposed to acknowledge the importance to engineers and architects of the art of selecting materials ; but to call this '*Geology,*' and to pretend that it is capable of facilitating our knowledge of the productions of a country, is to say the least of it, erroneous.

presence of peculiar organic remains, the first strata of which are connected by a gradual advancement in the number and characters of their fossil contents with newer deposits. Some of these beds were known, others were either not known, or mistaken for rocks connected with, or belonging to the coal measures.

The *upper Silurian*, or Ludlow formation, consists of red and yellow compact micaceous sandstones, bluish grey mottled limestone, and slaty impure argillaceous slates containing lime and sandy particles. The upper stratum of Silurian rocks, where it dips beneath the old red sandstone, is covered by the remains of large fish bones, shells, and coprolites, called the bone bed. The remains contained in this bed partake equally of those forms, (chiefly fishes,) which are found in the upper Silurian, and lower old red system.

Below these strata the rocks generally lose the appearance of sandstone, and contain more calcareous matter, which is mixed up mechanically in an argillaceous paste.* The strata are usually thin bedded, but are not so compact as to answer for flagstones. The surface of the beds present a waved undulating appearance, like the ridges and furrows occasioned by the rippling action of waves, to which the appearance is partly due. Mr. Murchison, however, thinks some of the transverse markings have been occasioned by animals, such as lived on sandy shores. The animals whose remains characterise these upper beds, are *Leptæna lata*, t. vii. fig. 15, *Cypricardia amygdalina*, t. vii. fig. 3 *Orbicula rugata*, t. vii. fig. 19, and *Avicula lineata*, t. vii. fig. 18, which also occur in the lower beds of the old red system.

* These stones are used for building, but they do not answer well, unless when used immediately after extraction from the quarry, when they require to be laid horizontally in the direction of their slaty laminæ.

Serpuloides (?) *longissuna*, t. vii. fig. 1, and of Crustacea,* *Homalonotus knightii*, (König.) t. viii. fig. 9, 10,* and *H. Ludensis*, Murch. t. viii. fig. 11, *Orthocerus Striatum.* Some beds contain a small species of Turbo, T. coralii, invested often with a species of coral, *Favosites fibrosa*, Gold fuss. The third stage of the upper Silurian rocks becomes micaceous, and more argillaceous, occasionally running into large spheroidal concretionary forms; these beds contain fewer organic remains, but the lowest beds of this division are characterised by a species of *Terebratula*, *T. navicula.* t. vii. fig. 16.

Ludlow or Aymestry Limestone.—The beds just described are occasionally called the mudbeds, from their loose friable structure. They are succeeded by a subcrystalline argillaceous blue, or bluish grey limestone of laminated structure, produed by shells and corals. The characteristic fossils of these beds are, *Pentameris Knightii*, t. viii. f. i. a. (fig. 1, b. the young.) *Lingula Lewisii*, t. viii. fig. 4, *Terebratula Wilsoni*, *Bellerophon Aymestriensis*, t. viii. fig. 5, *Avicula Reticulata*, t. viii. fig. 6; and corals, *Favosites Gothlandica.* t. viii. fig. 7, 8, *Atrypa Affinis*, *Terebratula Affinis*; but where the latter become characteristic, *Pentamerus Knightii* disappear. These limestone beds are distinguished by the name of the place where they were first discovered by Mr. Murchison, are much less pure than those of the mountain limestone, but their earthy character renders them of great value, as affording a cement which sets in subaqueous operations. Crystals of carbonate of lime and sulphate of barytes are the only minerals observed by Mr. Murchison in this limestone.

* We have selected from the numerous plates in Murchison's work, figures of a few of the most characteristic fossils, of which we have compiled the plates referred to in the text, in order that these remarks, in the absence of the original work, may be more intelligible and useful to observers in India.

Lower Ludlow Rock.—Beneath the latter beds, calcareous thin bedded flagstones occur; the strata seams are formed by thin layers of sandstone; occasionally a substance like fuller's earth occurs between the beds. The colour of the rock in situ is dark grey or black, but it weathers, like all similar beds of the upper Silurian system, to light ashen grey. These beds are distinguished by many peculiar organic remains, which have not been observed in any overlying stratum, viz. *Cardiola interrupta*, *Phragmoceras Nautileum*, t. viii. fig. 12, 13, *Orthocerus filosum*, *O. Pyriforme*, t. viii. fig. 2, *Lituites giganteus*, together with Trilobites, as *Calymene Blumenbachii* and *Asaphus caudatus*, but these last fossils are equally found in the subjacent beds. With the exception of thin seams of galena, and a little iron pyrites, no minerals have been found in this rock. The entire thickness of the Ludlow rocks is estimated by Mr. Murchison at 1,500 feet.

Wenlock Limestone, or Ballstone. The next member of the Silurian system corresponds with a limestone which projects abruptly through the coal formation at Dudley, where the intermediate beds being wanting, it was impossible to ascertain its place in the geological series. This limestone is distinguished by its containing masses of a crystalline limestone, highly charged with corals and encrinites, so much so, as to be liable to be mistaken for mountain limestone; but on further enquiry, it is found, that the crenoidal remains contained in this rock are peculiar to itself, or at least distinct from those of the mountain limestone. The ordinary colour of the rock is dark grey, freckled with veins and strings of white carbonate of lime. The beds are broken and irregular, with deposits of shale contained in the crevices. This last is so abundant, as to give the limestone an earthy appearance, and to constitute one of the best characters of the rock. In other cases, all traces of bedding are wanting, and the whole calcareous mass is made up of concretions

called ballstones,* sometimes of immense size, surrounded by beds of shale and impure limestone.

Beneath these beds, a shale containing concretions of very impure limestone occurs. These beds, which are called Wenlock shale, constitute the base of the upper Silurian rocks. These beds are succeeded occasionally by courses of very impure lenticular limestone, the concretions of which contain concentric figures, made up of dark coloured crystalline carbonate of lime in an argillaceous paste.

The Wenlock portion of the upper Silurian rocks is estimated by Mr. Murchison at about 1000 feet in thickness; that is, 300 feet for the limestone, and 700 for the beds of shale.

The minerals found in it, are calcspar, sulphate of barytes, lead and iron, peroxide of manganese, sulphurets of copper and bitumen, but not in such abundance as to render any of them of much value.

The organic remains on which the peculiarity of this rock depends, consist of

CORALS.

Heliopora pyriformis, (De Blain.)
Catenipora escharoides, (Lamarck.)
Stromatopora concentrica, (Goldf.)
Favosites Gothlandica, (Lamarck.)
Cyathophyllum turbinatum, (Goldf.)
Simaria clothrata, (Steininger.)

CONCHIFERS.

Euomphalus discors,
———— rugosus.
———— funatus,
Productus Euglyphus,
———— depressus,

* These are used as a flux for iron ore, and preferred, Mr. M. remarks, to the impure limestone.

Atrypa tenuistriata,
——— aspera,
Terebratula imbricata,
————— cuneata,
Nerita haliotis,
Orthoceras Brightii,

TRILOBITES.*

Asaphus caudatus, } Common to the Ludlow
Calymene Blumenbachii, } and Wenlock beds.

Calymene variolaris, Parkin }
———— *macrophthalma,* Brong. }
———— *Downingiæ,* }
———— *tuberculata,* }
Asaphus Stokesi, Murch. } Peculiar to the Wenlock formation.
———— longicaudatus, id. }
Bumastus Bariensis, id. }
Paradoxides bimucronatus, id. }
————— *quadrimacronatus,* id. }

The shale of the Wenlock formation is also distinguished by

Productus transversalis.
Spirifer cordiospermiformis,
——— trapezoidalis,
Terebratula brevirostra,
————— interplicata,
————— imbricata,
Orthoceros attenuata,

The following are common to all the Silurian rocks:—

Atrypa affinis.†
Productus depressus, var. pl. 12, fig. 2.

* Examples of these fossils shall be figured in future numbers when we arrive at that portion of the work in which they are described in detail by W. S. MacLeay, Esq., they are of the more interest, as none have as yet been discovered in India.

† Terebratula affinis, Sow. Min. Con.

THE LOWER SILURIAN ROCKS.

Caradoc Sandstone.—Unlike the upper Silurian rocks, these are composed essentially of sandstone of different colours, with an occasional thin bed of impure sandy limestone. In these beds, all traces of the Trilobites common to the upper Silurian rocks are lost, and in place of them occurs *Trinucleus caractace*, Murch., which belongs to a genus never observed in the upper Silurian rocks. The upper group of this division of Silurian rocks is described by Mr. Murchison as thinly laminated sandy shale, only slightly micaceous, containing layers of pipe clay and thin bands of impure sandy limestone. The fossils characteristic of these beds are,

Productus sericeus,
Bellerophon bilobatus,
B. acutus,
Littorina striatella,
Orthis alternata,
——— callactis,
——— canalis,
——— pecten,
Avicula obliqua,
Arbicula granulata.

The upper beds of this formation dip beneath the Wenlock shale, and the lower strata graduate into flagstones. On fracturing these flagstones, Mr. Murchison remarks, the fossils stand out in neat casts covered with brown and yellow hydrate of iron, presenting a marked relief from the dingy yellow olive green sandstone.

The characteristic fossils in this group of flag strata are,

Orthis actonia,
O. grandis,
Trinucleus caractace,
T. fimbriatus.

This group of Caradoc sandstone, Mr. Murchison thinks, is not less than four hundred feet thick. The flags are

in some places worked for troughs, tomb-stones and building purposes.

The calcareous grit forming the lowest bed of the Caradoc formation, contains

Terebratula (orthis) anomala,

Pentamerus oblongus, and the plumose Coral,

Calamopora fibrosa, Goldf.

The Caradoc sandstone reposes on deep reddish purple sandstones, with streaks of dirty yellowish-green, in beds from six inches to two and three feet. Where these beds are exposed, Mr. Murchison found in their superficial strata casts of

Orthis flabellulum,
O. vespertilio,
Terebratula unguis,

These beds are dissimilar to any of the overlying strata from their red colour and intermixture with clay and marl. In other situations, the section of these lower Silurian rocks present

"Grits and coarse sandstone of brown and yellow colour. Pure white grained sandstone, consisting of grains of sand imbedded in a matrix of felspars, which decomposing, give the whole a freckled appearance. Yellowish sandstone with ferruginous streaks, deep red sandstone, and whitish gritty sandstone."

These sandstones are in places cut through and thrown into vertical position by eruptive trap rocks. In other situations, quartzose pebbles are held together by a ferruginous cement. This formation is liable to be mistaken for old, or even new red sandstone; but its best distinction, says Mr. Murchison, consists in its position below the upper Silurian rocks, and in its organic remains, which are different from those of any formations that overlie it.

The minerals which occur in the lower Silurian rocks, are green carbonate of copper, and other copper ores, thin seams of galena with associated crystals of blende; and

where the beds are much disturbed by trap rocks, rich and productive lead veins are found.

The following is a general list of the fossils of the lower Silurian rocks:—

Arca Eastnori,
Avicula orbicularis,
——— obliqua,
Atrypa (Spirifer) crassa,
——— undulata,
——— lens,
——— plana,
——— globosa,
——— polygramma,
——— orbicularis,
——— hemispherica,
——— affinis,
Bellerophon trilobatus,
————— acutus,
————— bilobatus,
Bucinum (?) fusiforme,
Euomphalus tenuistriatus,
————— perturbatus,
————— corudensis,
————— funatus,
Lingula attenuata,
Leptæna* (Producta) sericea,
———— complanatus,
———— duplicata,
———— englypha,

* Atrypa, Leptæna, and Orthis, are subdivisions of the great genus Terebratula. Leptæna are distinguished in little from the genus Producta. Atrypa are Spirifers, with a short hinge, and destitue of foramen, or having a small triangular one; and with acute, not perforated beaks.

Orthis is distinguished from Spirifer, by its long narrow hinge and circular flat striated shell.—Ed.

Leptæna depressa,
———— tenuistriata,
Littorina striatella,
Lituites cornuarctis,
Nautilus nodosus,
Nucula (?) lævis,
Orbicula granulata,
Orthis grandis,
——— expansa,
——— alternata,
——— compressa,
——— protensa,
——— anomala,
——— pecten,
——— semecircularis,
——— flabellulum,
——— virgata,
——— radians,
——— costata,
——— actoneæ,
——— callactis,
——— lata,
——— triangularis,
——— canalis,
——— testudinaria,
——— bilobata,
——— vespertilio,
Pentamerus lævis,
————— oblongus,
Pleurotomaria angulata,
Spirifer radiatus,
——— plicatus,
——— alatus,
——— liratus,
——— lævis,

Terebratula furcata,
unguis
Terebratula neglecta,
——— tripartita,
——— decemplicata,
——— pusilla,
Tentaculites scalaris,
——— annulatus.

Llandeilo Flags.—The lower strata of Silurian rocks consist of flags, named by Mr. Murchison like the other formations from the place in which he found the strata best developed. They consist of hard, dark-coloured flags, sometimes slightly micaceous, frequently calcareous, with veins of white crystallized carbonate of lime. These beds are, however, better distinguished as the repository of large Trilobites, called *Asaphus Buchii*, Bron. and *A. tyrannus*, Murchison. These flags pass under ridges equivalent to the Carodac, and are seen in some situations to graduate downwards into the older strata of the Cambrian or primary rocks, the upper portion of which consists of overlying masses, containing a few calcareous courses, with casts of fossils, and at intervals thick and massive bands of prophyritic trap, as well as thinly laminated yellowish green bands of compact felspar, and other rocks of igneous origin. Among the fossils found in these beds, Mr. Murchison enumerates the following:—

Orthis anomala,
——— actoniæ,
——— canales,
——— compressa,
——— flabellulum,
——— lata,
——— pecten,
——— protensa,
——— testudinaria,

Bellerophon bilobatus,
Leptæna sericea.

As these fossils also occur in the lower Silurian rocks, no zoological division can yet be drawn between the lower Silurian and upper Cambrian groups.*

And as great lines of disturbance generally mark the frontier of the two groups, the difficulty of defining their common boundary is much increased. On the line of demarcation may occasionally be seen the various Silurian rocks, and the quartzose slaty sandstone passing into a coarse grit, or greywacke of foreign geologists; usually grey, but it is sometimes brownish and other ferruginous colours, and containing casts of encrinites and corals, but in general void of fossils.

The lower flags of the Silurian system (in those situations in Wales where the junction is not interrupted by intrusive trap, as on the western sides of the Grongar hills,) rest on black schists, which overlie the Cambrian strata. These schists are considered by Mr. Murchison and Professor Sedgewicke, as the link that connects the Silurian and Cambrian systems. Mr. Murchison remarks, that the trilobites and fossils of those beds bear so near a resemblance to those described by Mr. Brongniart, from Angers in France, that he regards the black flags in both places as the same.†

Although the upper Cambrian rocks do contain fossils in some places, in Caermarthanshire they do not. Even in those places in which fossil remains have been found, it is not in the fine slaty beds whose structure is so well calculated to preserve organic fossils that they occur, but in occasional courses of hard grits or sandstones, which re-appear at wide intervals in the schist.

These greywacke rocks, or grey micaceous slaty sandstones and compact regenerated slates, often containing fragments of older rocks in a quartzose cement, are gene-

* Murchison's Silurian System, p. 308.

† Silurian System, p. 358.

rally highly inclined at their junction with Silurian rocks, indicating a period of great physical changes to have elapsed between the time they were consolidated and the commencement of Silurian deposits.

Trap and altered Silurian Rocks.—Great outbursts of trap rocks took place during and after the accumulation of Silurian rocks. Mr. Murchison describes tracts of Caradoc sandstone cut and thrown up into vertical beds in a state approaching to quartz rock, being much indurated, and in parts cellular. Where the sandstones come in contact with trap, it is only to be detected in the state of true quartz; in most instances, the traces of bedding being quite destroyed. Trap rocks when erupted in contact with schist, convert it into an indurated form, or Lydian stone; of this there are several instances, vide Murch. p. 320, where the schist has been originally perhaps of bituminous character, as shale; anthracite is not an uncommon mineral in the altered rock. Mr. Murchison details an instructive instance of this nature, where a credulous farmer ruined himself by mistaking one of these indications of anthracite in the lower Silurian rocks for coal.

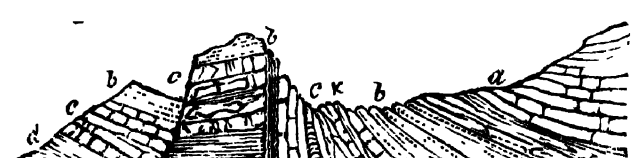
Greenstone often contains fragments of the rocks through which it is projected in a state more or less altered; sometimes black crystals of carbonate of lime, iron pyrites, and little flakes of anthracite and mineral waters; when these issue from contiguous springs in volcanic districts, they are often very different in their nature, but when issuing from greenstone they are generally sulphureous and saline.

The older Silurian rocks are covered, in certain localities described by Mr. Murchison, with stratified sedimentary rocks, alternating with nodular concretionary deposits, which he regards as volcanic grit, proving that repeated igneous action took place during the period when the upper Silurian strata were accumulating.

In some instances stratified trap rocks, consisting of concretions of compact felspar, containing crystals of common

felspar, hornblende, and iron pyrites, with a little disseminated lime alternate with flags, containing *Asaphus Buchii*, and other trilobites of the lowest beds of Silurian rocks. The beds of volcanic and sedimentary rocks are conformable, one above the other, indicating so many distinct alternations of volcanic and sedimentary deposit. From evidence of this nature, Mr. Murchison has shewn, that submarine volcanic eruptions were frequent during the formation of the lower Silurian beds, while the upper Silurian rocks and old red sandstone were formed during a long period of tranquillity, after which, these last deposits were dismembered and thrown up by vast outbursts of intrusive trap. Mr. Murchison is further led to the conclusion, that the carboniferous system was deposited in vallies after the older strata had been upheaved, and that subsequent dislocations, including some of the most violent with which we are acquainted, took place after the accumulation of the coal measures and lower new red sandstone. How far these conclusions may be borne out, or modified by the observations of geologists in other parts of the world, we are not yet prepared to say; but we feel strongly impressed with their general accuracy in regard to geological facts in India.

The following examples of the dislocations of Silurian rocks in Wales, are given by Mr. Murchison. The first is a complicated fault by which a mass of Aymestry limestone(*c*)



has been thrown into nearly vertical position abutting against the edges of a mass of similar limestone, which has been thrust up between the highly inclined strata and another dislocated mass. Each of these bands of limestone (*c*) is capped

by the stratum charged with *Terebratula navicula*, and underlaid by the Pendle beds *(d)* of the lower Ludlow rock.

The locality in which this fault occurs in the Silurian rocks, is situated between two great axes of volcanic outburst, the Dee Hills and the Caradoc, to which this and other similar dislocations in the same district may be ascribed.

One of the effects of sudden outbursts of volcanic rocks, amidst consolidated strata, is to separate the latter; if this be at the same time accompanied with great elevatory movements, large masses of the disturbed strata are liable to give way and become detached. These Mr. Murchison calls outliers. It is always necessary to be able to distinguish outliers, since they are often associated with formations to which they do not belong. Their investigation also, is calculated to throw much light on the circumstances under which the causes which produced them took place. Three outliers of the Ludlow rocks are described by Mr. Murchison; one of these, called Tinker's Hill, rises on the south-west bank of the Teme. It consists chiefly of small nodules imbedded in sandy calcareous shale, occasionally united into flag-like beds of bluish grey earthy limestone, containing *Terebratula Wilsoni*, and other characteristic fossils of the lower Ludlow rocks. This outlier is two miles in length, and is parallel to the main direction of the Silurian deposits.

The direction of the joints and fractures of strata is also an important point, on which subject the reader is referred to Phillip's Geology. In some chains, Mr. Murchison remarks there are long fissures, either coincident with the line of elevation, or nearly at right angles in the direction of the dip. These may frequently, Mr. M. remarks, be ascribed to the elevation of strata *en masse;* but must not be confounded with the symmetrical lines by which beds of rock are often intersected, and which are often the greatest convenience in quarries; for where these straight chinks cut the rocks across their bedding, there is little more to be done

than remove the detached masses, as these fissures are unattended with any displacement of strata. They are ascribed to one of the last changes to which the strata affected by them were exposed after their deposit. Crystalline forces have been supposed by Professor Sedgwicke to have had some effect in producing such fissures as these, as well as the slaty cleavage of rocks. Mr. Murchison, however, thinks that such joints in strata have been occasioned by heat, particularly as they seem to be more frequent in the vicinity of fissures of eruption, and particularly in those strata that have been altered by the effects of heat.

Landslips of the Silurian Rocks.—These are referred by Mr. Murchison to the jointed condition of the strata, and their inclined position on the surface of steep ridges, together with the softening or decay of subjacent beds.

Wells in Silurian Rocks.—The jointed structure of the strata already noticed, renders them permeable to water, while, faults, dykes and dislocations act as dams to it, and thus it is obliged to find some other outlet, thus also lines of faults are often traceable by the outburst of springs; singular springs of this kind are referred to by Mr. Murchison, of which every mountainous tract may afford instances. Mineral springs depend on similar causes, the peculiar properties of their waters being derived from the strata through which they permeate.

Mining Ground of Silurian Rocks.—This is situated in the altered rocks, where they come within the influence of trap. Several veins of galena, common and steel grained, are worked; also carbonate of lead, both crystallized and stalactitic. The veins are chiefly parallel to the strike of the strata; but some are in the form of the letter N. Nearly all the veins diverge in separate strings; many of the best and richest ores being found in the points of intersection. The ordinary ores yield from six to seven ounces of silver per ton. Some of the veins were first worked by the Romans,

whose mining implements are found in them. In one of the principal veins, says Mr. Murchison, the wall is granular felspar, with green earth; and two contiguous bosses of crystalline greenstone rising up unconformably through the strata of sandstone and shale, *cut* off the productive veins. In this case, Mr. Murchison is of opinion, that there has not been a sufficient quantity of contiguous sandstone and shale to afford *ground* for the production of the ore. The altered rocks in which the only instances of metalliferous veins occurred to his observation throughout the Silurian rocks, were situated in the vicinity of intrusive trap, and that the best veins of galena were found in the lower Silurian rocks near the great outburst of trap. In the shales and sandstones connected with the altered rocks in which the veins of galena are situated, Mr. Murchison found Trilobites,* identical with those of the lowest flags of the Silurian system, together with many shells of the Caradoc sandstone, and thus even in altered disrupted strata he was able to discover the true nature of the rocks in which metallic veins occur in distant situations.

Three of the lead mines situated in lower Silurian rocks of Shropshire, described by Mr. Murchison, near the village of Shelve, afford the following produce:—

Bog mine, ...	1,554 tons of lead,
Snail batch, ...	1,300, ditto,
Grit and gravel mine,	685, ditto.
Total,	3,539

The present depth of the engine shaft of the Bog mine is 293 yards, and the lowest working level 265 yards, the upper working above the adit or boat level 105 yards. In this district, Mr. Murchison observes, there are thirty veins that have been profitably worked.

The Stiper Stones, is a barren naked ridge of quartz rock

* In a future number we hope to give examples of these curious fossils from Mr. Murchison's work.—Ed.

or altered sandstone, which has been thrown up like a wall between two mining districts, the one affording copper and the other lead ores.

Agricultural character of the Silurian Rocks.—The upper Silurian rocks, when not covered by transported materials, afford a good substratum of clay and sand, owing to the jointed and fissured character of the strata; the soil is dry, the water having once passed through the thin covering of earth enters the rocks, and is thus carried off from the land, which notwithstanding affords good crops of barley, oats, and turnips, as well as good timber.

On the other hand, the second division of the upper Silurian rocks, called Ludlow and Wenlock formations, being soft and argillaceous, and subject to the drainage of water, are comparatively cold and unmanageable, except where limestone rocks afford an intermixture of calcareous matter, which yields excellent crops of wheat.

The lower Silurian rocks afford quite a different character. These rocks being for the most part of a sandy structure, disintegrate into short, not very productive soil; but where the quartzose conglomerates prevail, the surface is sterile. The lowest portion of these rocks consisting of flags, is often, as might be expected from the nature of the beds, rich and productive, particularly in Cærmarthenshire, although where much invaded by trap rocks, as in the mining vicinities of Shropshire, the soil is generally poor.

Lowest Fossiliferous Beds.—As the series of strata extending from the old redstone down to the non-fossiliferous slates has been until lately regarded as a single group, exhibiting the remains of the earliest animals introduced upon the earth, we cannot appreciate too much investigations which are calculated to extend our views to periods so remote as those which the earliest fossiliferous strata refer to. Professor Jameson we believe to have been one of the first observers who discovered the elements of dis-

tinct formations between the old red sandstone and non-fossiliferous slates, and the two groups, which he named the older and newer transition rocks, would appear to refer to those divisions of Silurian strata the peculiarities of which have been so well illustrated by Mr. Murchison in the great work before us. In the Plinlimon, or dark and indurated slaty sandstone, which forms the intermediate beds between the Silurian rocks of Murchison and the Cambrian system of Professor Sedgwicke, no fossils have been found, while nearly all those of the 'Bala' or dark limestone overlying the Cambrian or primary rocks, contain fossils identical with those of the lower strata of the Silurian system. Perhaps these beds, as well as the grauwacke of foreign geologists, should still be included in the same system with Silurian rocks. Mr. Murchison and Professor Sedgwicke, however, think otherwise, and while the former has given positive characters to Silurian rocks, the investigations of the latter, when fully before the public, will go far, no doubt, to cast as much light upon the Cambrian system, as the nature of the beds composing it will admit of.

Experiments on the Magnetic Influence of Solar Light. By Lieut. R. BAIRD SMITH, *Bengal Engineers.*

The repeated ebb and flow of opinion among scientific men, as to the existence of a magnetic influence in solar light, gives a curious degree of interest to the history of the question. The discovery was originally announced in 1813, by Prof. Morenchini of Rome, who asserted, that by exposing steel needles in a particular manner to the violet ray of the solar spectrum, he had succeeded in imparting to them a perceptible magnetic polarity. These experiments were repeated in the presence, and apparently to the entire satisfaction of Sir Humphrey Davy, Professor Playfair, and certain other English philosophers, who happened, at the

time of their announcement, to be in Rome. The subject was altogether a curious one, and Morenchini's experiments were repeated in various quarters, and with various success. MM. Carpa and Ridolphi produced results similar to those alluded to above, but M. Berard of Montpelier, M. Hombre Firmas at Alais, and Professor Configliachi of Pavia, failed utterly in obtaining any evidence whatever of magnetic action. The balance of credit appears to have inclined in favour of the latter observers, since the discovery fell into disrepute until in 1825 it was again prominently forced on the attention of scientific men by some ingenious and apparently very decisive experiments of Mrs. Somerville. She was at the time unacquainted with the details of Morenchini's method of observing, but as it appeared to be improbable that the same cause acting upon a needle could give rise both to a northern and southern polarity, she protected one half of each of those employed by her from the influence of the sun's rays by covering it with paper, allowing the light to act on the other half. Proceeding thus, she obtained the most marked results, of which a brief detail may here be given. Having covered half of a sewing needle, about an inch long, with paper, she exposed the other half uncovered to the violet ray of a spectrum thrown by an equiangular prism of flint glass on a pannel at five feet distance. As the place of the spectrum shifted by the motion of the sun, the needle was moved so as to keep the exposed part constantly in the violet ray, and after being thus exposed for two hours, the previously unmagnetic needle exhibited decided polarity, the exposed end having the properties of a north pole. Repeated experiments were made with needles of different sizes, and placed in different positions with reference to the magnetic meridian, and with results uniformly of the same kind as the preceding. Needles were then in turn exposed to the other rays of the prismatic spectrum, and it was found, that while the indigo ray was nearly as

effective as the violet, the blue and green rays only occasionally succeeded, and the yellow, orange, and red, never did so, although the same needles were exposed to their influence for several successive days. Subsequently, experiments were tried with solar light, transmitted through various coloured media, and it was found, that needles half covered with paper, and exposed under a glass coloured blue by cobalt, became after three or four hours feebly magnetic, and after six hours, sensibly and permanently so. Similar results were produced with green glass, and also with blue and green riband. Such is an outline, although no more, of the experiments of Mrs. Somerville, but I regret exceedingly, that I have been unable to procure any detailed account of the various steps in her method of observing, since although the results appear sufficiently decisive, it would have been very desirable to have had the power of remarking whether *all* sources of error had been foreseen and eliminated by her; especially as the method employed by her is one in which many such sources exist, as will afterwards be more particularly alluded to.

In repeating the experiments of Mrs. Somerville, M. Baumgartner of Vienna discovered that a steel wire, some parts of which were polished, while the rest were without lustre, became magnetic by exposure to the white or undecomposed light of the sun, a north pole appearing at each polished part, a south pole at each unpolished part, and the effect was hastened by concentrating the light upon the wire by means of a lens. In this manner eight poles were obtained on a piece of wire eight inches long.

The magnetic influence of solar light was exhibited in another form by Mr. Christie of Woolwich in 1825, he having found that the vibrations of a magnetized needle when exposed to the sun's light, ceased in a much shorter time than when it was vibrated in the shade, and this independently altogether of the effect of temperature. This

effect, however, was not confined to needles that had been magnetised, since it was found to apply also to unmagnetised needles, to needles of glass and copper, vibrated by the force of torsion, with all of these it was found the arcs of vibration diminished in amplitude more rapidly in the sun's light than in the shade, in the following proportions; the terminal excess (that is, the excess of the terminal arc in the shade above that in the sun, after the same number of vibrations commencing from the same point in each case) would by the first series of experiments, be for the magnetised needle 13° 75′; for the copper needle 5° 24′; and for the glass needle 4° 71′—and by the second series of experiments, for the magnetised needle $11\frac{1}{4}$°; for the unmagnetised needle 7° $\frac{5}{12}$′; for the glass needle 6° $\frac{1}{5}$′; and for the copper needle 5°. "To whatever cause," Mr. Christie remarks, "we are to attribute the singular fact, that any needle will come sooner to rest when vibrated exposed to the sun than when screened, the great increase of effect which is observed when a magnetised needle is made use of, proves, I think decidedly, that the compound rays possess a very decided magnetic influence."

The experiments of Mr. Christie were repeated by Mr. Zantedeschi of Pavia, who found that by exposing the north pole of a needle, a foot in length, the semi-amplitude of the last oscillation was 6° less than the first; while on exposing the south pole, the last oscillation became actually greater than the first, a result, it must be remarked, of the most extraordinary character. This observer, however, admits, that he frequently met with the most inexplicable anomalies in his experiments; and in the abstract of them which I have seen, they are recorded in a style of peculiar vagueness and indecision.

The results now stated appear to afford a very marked confirmation to the idea of a magnetic power being resident in the solar rays, and yet a series of careful and

well conducted experiments by MM. Moser and Riess have again involved the whole question in its former obscurity, they having failed completely in producing any change of magnetic intensity in steel needles exposed to the solar rays. The method of observation employed by them was to count the number of oscillations performed in a given time *before* and *after* the needle was submitted to the action of the violet rays. So decisive were their results in indicating the invariable intensity of the needles thus exposed, and also so completely did they fail in verifying the results of Baumgartner, formerly alluded to, that they consider themselves entitled to reject wholly a discovery, which for seventeen years has at different times disturbed science. "The small variations," they observe, "which are found in some of our experiments, cannot constitute a real action of the nature of that which was observed by MM. Morenchini, Baumgartner, &c. &c. &c. in so clear and decided a manner." The latest authorities, as for instance Prof. Turner, in the last edition of his Elements of Chemistry, coincide in this view of MM. Moser and Riess, so that at present the discovery of the magnetic influence of solar light is again considered more than doubtful.

Such being the present aspect of the question of solar magnetism, it ardently invites to farther enquiry; and as it appeared to me that India offered several important advantages for the investigation of such a subject, I resolved to commence a series of experiments upon it, in the hope of obtaining some interesting or decisive results. We have here the command of a solar intensity both of light and heat, far greater than observers in temperate regions can avail themselves of, while the almost uninterrupted clearness of the weather during certain seasons, enables us to prosecute our experiments from day to day with facility and certainty. At the same time it must be remarked, that advantages such as these, are far from being unalloyed, since all ex-

periments requiring delicate apparatus and minute observation are attended in this country by peculiar difficulties—difficulties too that increase in rapidly accelerated proportions as we recede from large towns or stations. The mechanical resources necessary for the construction of scientific apparatus are peculiarly difficult to command, and in many instances, it is necessary to procure their most essential parts from great distances. Thus I have been unable to obtain a common prism from any place nearer than Calcutta, a distance of upwards of a thousand miles from the spot where these experiments have been made, and similarly with other parts of the apparatus I have employed. Still if difficulties such as these were to be allowed to deter us wholly from scientific research, but very little would be done in this country, since they meet us at every step—they may however be pleaded as a reason, why that minuteness of observation, confessedly so desirable, may not at all times distinguish our experiments, and will excuse the expedients to which we are occasionally obliged to have recourse to work out our views. Another disadvantage of localities so remote as that where the experiments to be subsequently detailed, were made, is the impossibility of obtaining books for the purposes of consultation. Of the various researches on the subject of solar magnetism to which allusion has been made, I have been able to obtain only the merest abstracts of the original memoirs, and have consequently been compelled to follow throughout my own experiments, that course which appeared to me best. The results I have obtained, I therefore give in the fullest detail, so that if any sources of error exist in them, they may readily be detected and allowed for. The experiments will be divided into the three following sections:—

Section I.—On the magnetic action of undecomposed light.

Section II.—On the magnetic action of the rays of the prismatic spectrum.

Section III.—On the magnetic action of the light, transmitted through different coloured media.

Section I.—*On the magnetic action of uudecomposed light.*

In proceeding to detail the experiments of this section, I would first describe the apparatus employed. The needles, or rather cylinders, used were of soft steel, of various lengths and diameters, as noted particularly in the subsequent tables, and having surfaces brightly polished. Each needle was fitted into a brass wire stirrup made in the following manner: a piece of very thin wire about two inches in length is bent double, a small loop is then formed by twisting the bent wire twice or thrice, leaving the ends about three-quarters of an inch long each—the wire is then placed on the centre of the needle, the right hand end seized by a piece of pincers and wrapped round the needle, and the same being done with the left hand end, the stirrup is complete. To the loop of the wire there were attached a few filaments of silk, for the purpose of suspension, the length of which, throughout the experiments, was 13 inches. The detached extremity of the suspending filament was inserted into the split made in a piece of straw, and on the needle being introduced within a large glass shade, to protect it from the wind or other disturbing causes, the straw was placed across the aperture in the top of the shade, and thus supported the needle during its oscillations. At the bottom of the glass shade was placed a graduated circle, over which the needle oscillated, and by which the oscillations were regulated.

Method of observation and adjustments.—The method of observation employed throughout this section, was to observe the time required to perform a certain number of oscillations before and after exposure to the sun's light. Since the same dynamical laws are applicable to needles oscillating under the influence of magnetic power, as to pen-

dulums vibrating under the influence of gravitation, and since in the latter case the squares of the times of performing a given number of oscillations are inversely proportional to the force of gravity, it follows that in the former the corresponding law obtains likewise, hence then the higher the intensity of the magnetic force that acts on a vibrating needle, the more rapid will its oscillation be, and therefore by comparing the times of its oscillations under different circumstances, any variation of intensity that it may have undergone, will immediately become apparent. Accordingly, by vibrating a needle before its exposure to the sun's light, a distinct indication of its magnetic condition is obtained, while by vibrating it after its exposure, the change consequent on this exposure becomes perceptible. There cannot be a doubt of this being by far the best, and indeed I believe the only sure method of judging of changes of magnetic condition, and it is the employment of it that makes the experiments of MM. Moser and Riess so much more decisive than those of Mrs. Somerville or others, by whom a different method, to be afterwards described, was employed. During exposure, the needle was placed upon a table, and it ought to be in a direction at right angles to the magnetic meridian, since there is then the least possible chance of any interference of terrestrial magnetism with the results due to the action of solar light. This was not done by me at first, as the chance of error from the source alluded to, did not occur to me; but in the later experiments it was invariably attended to, and ought always to be borne in mind, since feeble magnetism may be imparted to a steel needle held in the direction of the magnetic meridian, especially if it approaches the line of magnetic dip, by the mere inductive action of the magnetism of the earth. While placed, therefore, in this proper position, the direct light of the sun concentrated into a focus by means of a lens 1-5th of an inch in diameter and one inch focal distance, was made to traverse

one-half of the needle, invariably from right to left, a specified number of times. The exposed end, for the sake of clearness, will always be styled the *marked* end, it having been distinguished from the other by a small black dot, this other end, being the *unmarked* one. After exposure, the needle was replaced in its stirrup, and allowed to take up a fixed and settled position, so that there might be no remains of torsion in the silk filaments to interfere with the freedom of its vibrations. It was then carefully adjusted, so as to coincide with the zero line of the graduated circle, its centre being placed exactly over the centre of the circle ; a slender rod of straw introduced within the glass shade through the aperture at its top, and by means of this rod a slight impetus was communicated to the needle, by which its oscillations were established. These were allowed to diminish until the arc had a semi-amplitude of 54°, from which, as from a fixed point, the counting and registering commenced in every case. The time was registered every 60 seconds by the aid of an excellent watch, although from this not having a stop, it was a little difficult to read off with the exactness required. The results in the following table are given as they were obtained at the time of experiment, with the exception, that whereas I then endeavoured to register the amplitudes of the first and last oscillations, I found it afterwards so difficult to attend to both these and the times, that I struck out the former and attended wholly to the latter. The temperature, as being an element of some importance in experiments such as the present, is given in degrees of Fahrenheit, the needle was frequently very warm after exposure, but invariably became perfectly cold again long before the experiments with it were closed.

I now proceed to give numerical details, and adopt the tabular form, as being in every respect the most convenient and concise.

Tables of Experiments.

I.—*Experimental Needles of soft steel, and having brightly polished surfaces.*

TABLE I.

Shewing the Duration of Oscillations of Needle A. before exposure.

No. of Exp.	Date of Exp.	Hour of day. A. M.	Hour of day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		
1	10th	11	...	4	0·05	63°	5	76?	0	
2	...	...	...	...	...	...	5	85?	...	Needle not properly adjusted. Observation rejected.
3	...	...	...	...	...	...	5	92	...	
4	...	...	...	...	...	...	5	99	...	
5	...	...	...	...	...	...	5	96	...	
6	...	...	...	...	...	...	5	97	...	
7	...	...	...	...	...	...	5	98	...	
8	...	...	...	...	...	...	5	97	...	
9	...	...	...	...	...	...	5	98	...	
10	...	...	...	...	...	...	5	99	...	
						Sums, ...	50	861		
						Means, ...	1	19·15		

This Table being the first, exhibits considerably greater differences between the times observed than subsequent ones do, as greater facility in reading off was gradually obtained. From the circumstance previously alluded to, of the watch employed to register the times, by having no stop, single seconds may have occasionally been lost or gained during the intervals of observation; an error of this kind would, however, compensate itself in a series of observations, since the probabilities are as much in favour of its being in one direction as the other. During the day on which the above and succeeding Tables of Experiments were made, the sun was slightly clouded, so, that both its light and heat were to a certain degree interfered with.

TABLE II.

Shewing the Duration of Oscillations of Needle A. after exposure.

No. of Exp.	Date of Exp.	Hour of day. A. M.	Hour of day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		
1	10th	...	1	4	0·05	85°	5	99	200	
2	...	...	...	...	...	...	5	100	...	
3	...	...	...	...	...	...	5	100	...	
4	...	...	...	...	...	...	5	101	...	
5	...	...	...	...	...	...	5	101	...	
6	...	...	...	...	...	...	5	99	...	
7	...	...	...	...	...	...	5	98	...	
8	...	...	...	...	...	...	5	99	...	
9	...	...	...	...	...	...	5	100	...	
10	...	...	...	...	...	...	5	100	...	
						Sums, ...	50	997		
						Means,...	1	19·94		

TABLE III.

Shewing the Duration of Oscillations of Needle B. before exposure.

No. of Exp.	Date of Exp.	Hour of day. A. M.	Hour of day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		An error in counting one vibration too many has evidently been made here. The Observation is therefore rejected. An error of this kind is very easily made.
1	12th	11	...	4	0·05	65°	20	314	0	
2	...	...	...	...	...	...	20	300	...	
3	...	...	...	...	...	...	20	300	...	
4	...	...	...	...	...	...	20	300	...	
5	...	...	...	...	...	...	20	302	...	
6	...	...	...	...	...	...	20	300	...	
7	...	...	...	...	...	...	20	301	...	
8	...	...	...	...	...	...	20	300	...	
9	...	...	...	...	...	...	20	299	...	
10	...	...	...	...	...	...	20	300	...	
						Sums, ...	200	3016		
						Means, ...	1	15·011		

TABLE IV.

Shewing Duration of Oscillations of Needle B. after exposure.

No. of Exp.	Date of Exp.	Hour of day. A. M.	Hour of day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		
1	13th	11	...	4	0·05	85°	20	302	200	Sun very bright and powerful, sky quite cloudless.
2	...	...	...	...	...	...	20	300	...	
3	...	...	...	...	...	...	20	302	...	
4	...	...	...	...	...	...	20	302	...	
5	...	...	...	...	...	...	20	299	...	
6	...	...	...	...	...	...	20	300	...	
7	...	...	...	...	...	...	20	301	...	
8	...	...	...	...	...	...	20	300	...	
9	...	...	...	...	...	...	20	300	...	
10	...	...	...	...	...	...	20	300	...	
						Sums, ...	200	3006		
						Means, ...	1	15.03		

TABLE V.

Shewing Duration of Oscillations of Needle B. after farther exposure.

No. of Exp.	Date of Exp.	Hour of Day. A. M.	Hour of Day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		
1	13th	...	1	4	0.05	97°	20	307	600	
2	...	...	...	...	...	...	20	304	...	
3	...	...	...	...	...	...	20	307	...	
4	...	...	...	...	...	...	20	306	...	
5	...	...	...	...	...	...	20	307	...	
6	...	...	...	...	...	...	20	306	...	
7	...	...	...	...	...	...	20	306	...	
8	...	...	...	...	...	...	20	308	...	
9	...	...	...	...	...	...	20	307	...	
10	...	...	...	...	...	...	20	307	...	
						Sums, ...	200	3065		
						Means, ...	1	15.352		

The needle *B.* was in every respect the counter-part of *A*, having been cut from the same piece of steel; the same stirrup and suspending filament were employed in both series of experiments, and the only difference between them was, that in order to ensure a greater degree of accuracy, a larger number of Oscillations was counted at each observation. The latter series were made under peculiarly favourable circumstances, the weather being still and clear, and the sun very bright and powerful, both in light and heat.

TABLE VI.

Shewing the Duration of Needle C. before exposure.

No. of Exp.	Date of Exp.	Hour of Day. A. M.	Hour of Day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		
1	19th	11	...	5	0.04	64°	20	610	0	
2	...	...	...	...	...	...	20	614	...	
3	...	...	...	...	...	...	20	616	...	
4	...	...	...	...	...	...	20	620	...	
5	...	...	...	...	...	...	20	615	...	
					Sums,	......	100	3075		
					Means,	......	1	30.75		

TABLE VII.

Shewing the Duration of Oscillations of Needle C. after exposure.

No. of Exp.	Date of Exp.	Hour of Day. A. M.	Hour of Day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		
1	19th	12	...	5	0·04	83°	20	615	200	
2	...	...	...	...	...	...	20	615	...	
3	...	...	...	...	...	...	20	615	...	
4	...	...	...	...	...	...	20	615	...	
5	...	...	...	...	...	...	20	617	...	
					Sums,	...	100	3077		
					Means,	...	1	30 77		

TABLE VIII.

Shewing the Duration of Oscillations of Needle C. after farther exposure.

No of Exp.	Date of Exp.	Hour of day A. M.	Hour of day P. M	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca		
1	19th	...	2	5	0·04	81°	20	624	600	
2	...	...	...	...	...	...	20	625	...	
3	...	...	...	...	...	...	20	624	...	
4	...	...	...	...	...	...	20	628	...	
5	...	...	...	...	...	...	20	626	...	
						Sums, ...	100	31 27		
						Means, ...	1	31·27		

The only difference between the details of these and former experiments consisted in one-half of needle C being covered by several folds of paper, while the other half was exposed to the Traverses of the focus of concentrated light. In order that the results obtained in the present branch of our enquiry may be exhibited at one view, the following table has been prepared.

TABLE IX.

Shewing general results of Experiments on the magnetic action of undecomposed Solar Light, with needles having brightly polished surfaces.

Nos.	Dates.	Needles.	Length of Needle.	Diam of Needle.	Duration of Oscill. before Exp.	Duration of Oscill. after 1st Exp.	Duration of Oscill. after 2nd Exp.	Remarks.
	Jan 1842							
1	10th	A	4	0 05	19·15	19 94	......	These observations were not all made on the same day, as will be seen in the table of details for each. They are however placed in this table as if they had been so, for the purpose of clear comparison.
2	12	B	[illegible]	0 05	15·011	15 03	15.322	
3	19	C	5	0 04	30·75	30·77	31 27	

From this table, it is perfectly clear that no increase whatever of magnetic intensity, had taken place in the needles A B and C, in consequence of their exposure to direct undecomposed solar light, a result in accordance with those of other observers, none of whom have ever succeeded

in imparting magnetism under the circumstances described. That the differences observable in the periods of Oscillation before and after exposure are due, at least in part, to minute and unavoidable differences in the conditions of experiment for each needle, I have but little hesitation in affirming, but their extent and uniformity of direction forbid their being attributed wholly to such a cause, and warrant a remark, which I am not aware of having been previously made, namely, that brightly polished soft steel needles, after being exposed for a certain time to the direct light of the sun, and subsequently withdrawn to the shade, will vibrate in sensibly longer periods than before exposure. That this result is not magnetic in its origin, is, I think, very clearly proved by the following experiments made with the express view of testing this point. An exceedingly slender sewing needle, about one inch in length, and one hundredth of an inch in diameter, entirely devoid of all magnetism, was suspended within a glass shade by means of a single filament of silk, about six or seven inches in length, forming a very delicate and sensitive testing apparatus for magnetic polarities. To this testing needle, each of the cylinders A B and C was in turn approximated, but not the slightest indication of polar action of any kind could be obtained, the needle being utterly indifferent to the presence of the cylinders. This result, both serves to verify that given by the different method of oscillations, and to shew that to whatever cause the longer periods of oscillation after exposure are to be attributed, there is no reason to believe that magnetism is concerned in producing them. That the action of the sun is capable of producing remarkable changes in the internal constitution of bodies, while their external appearance continues unaffected, has been very strikingly established by the experiments of M. Mitscherlich of Berlin, who has found, among other instances, that prismatic crystals of the metal zinc are completely changed

in form, becoming octohedrous by exposure for a few minutes to the action of the sun, and that by the same cause, prismatic crystals of nickel, without changing their external form, had become internally so altered as to exhibit when broken up, a series of octohedrons with square bases. Here, therefore, we have proofs of powerful internal molecular action consequent on exposure to the sun, and although it would be unwarrantable for me to conclude that such action had taken place in the steell needles also, the passing allusion I have made to M. Mitscherlich's results, will not be misplaced, if it shews that while no changes of magnetic condition took place in them, it is not impossible that changes of a different nature may have done so, and may have produced those dynamical differences to which reference has been made.

2nd.—Experiments with steel and iron cylinders in different degrees of Oxidation.

It being an established fact that a certain degree of oxidation pervading the mass, or distributed on the surface of steel or iron increase their susceptibility of magnetic influence, I was desirous of discovering whether the action of light could be made perceptible by using cylinders in this condition. The following experiments, were accordingly made with this view:—

TABLE X.

Shewing Duration of Oscillations of Needle D. before exposure.

No. of Exp	Date of Exp.	Hour of Day. A. M.	Hour of Day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses.	Remarks.
	Jan.			In.	In.			Sca.		
1	20th	10½	...	4	0.033	66°	10	261	0	
2	...	...	...	...	...	...	10	259	...	
3	...	...	...	...	...	...	10	258	...	
4	...	...	...	...	...	...	10	260	...	
5	...	...	...	...	...	...	10	257	...	
					Sums. ...		50	1295		
					Means. ..		1	25.91		

TABLE XI.

Shewing Duration of Oscillations of Needle D. after exposure.

No. of Exp.	Date of Exp.	Hour of Day. A. M.	Hour of Day. P. M.	Length of Needle.	Diam. of Needle.	Temp.	No. of Oscill.	Duration of Oscill.	No. of Traverses	Remarks.
	Jan.			In.	In.			Sca.		
1	20th	11½	...	4	0.033	97°	10	262	200	
2	...	...	...	...	...	...	10	262	...	
3	...	...	...	...	...	...	10	262	...	
4	...	...	...	...	...	...	10	261	...	
5	...	...	...	...	...	...	10	261	...	
					Sums. ...		50	1308		
					Means. ...		1	26.116		

The needle D was partially oxidated on the surface, the oxidation being distributed in small patches interspersed with brightly polished spots. It is clear from the two Tables, that no magnetic effect was produced upon it by exposure, and this result was verified by means of the testing apparatus formerly described. The experiments were, however, varied in the following manner. A sewing needle $1\frac{5}{8}$ inch long and $\frac{1}{32}$ of an inch in diameter was strongly magnetised by the aid of a horse-shoe magnet, which being placed on its centre, was made to traverse it backwards and forwards for sometime, the needle being occasionally turned round, and care being taken to pass over each portion of it an equal number of times, to insure equable distribution of its magnetism. It ought farther always to be placed in the magnetic meridian, and it may be useful to mention, that when two common bar magnets are employed instead of the horse-shoe one, to impart magnetism to a needle, their opposite poles must be placed upon its centre, and themselves being held inclined at an angle of about 23°, they must be drawn along the needle in different directions, then lifted perpendicularly, and carried well away from the needle, until they can be brought down again upon its centre, when

they are again drawn along it, and so on, until it has become sufficiently magnetised. The needle above referred to, was found after magnetization, to have acquired a northern polarity at its point, and a southern polarity at its eye extremities, by which I mean, that the former pointed to the north pole, the latter to the south pole of the earth. The polarities really acquired were therefore the converse of those I have stated, but custom has sanctioned the change of terms, and that point of a needle which turns to the north, is invariably called the north pole, although southern polarity really exists in it. Some writers insist on using the rigidly correct terms, and calling the common north pole of the magnet the south pole, but this has led to much confusion, and if any change at all is adopted, the best undoubtedly would be to dispense entirely with the terms north and south, and to call the end of the needle that turns to the north pole of the earth, the marked, and the other the unmarked end, as is frequently done by the best authorities. To return, however, the magnetised needle was suspended by means of a single filament of silk within a glass cylinder open at both ends, about six inches in height, and two inches in diameter, so that the needle vibrated freely within it. This apparatus was then arranged over a slit in a table, through which slit the wires or cylinders to be tested were placed in front of the testing needle, and could be raised or depressed in any way that was necessary. When the needle became stationary in the magnetic meridian, a mark was made on the glass cylinder exactly opposite the north pole, and another mark about 45° to the east of this; from the latter mark the registered oscillations commenced; and it remained constant throughout each series of observations. The method of observation employed was first to register the duration of a certain number of vibrations of the testing needle, with the wire under experiment placed at a certain known distance in front of it, before exposure to the sun's

light, and after exposure to repeat this process, the conditions of experiment continuing unaltered. The heights of the wires were measured from the surface of the table, about a quarter of an inch above which was the plane of the needle's vibration. Entire oxidation of the surface of a wire was effected by covering it with a little acid, and allowing this to act upon it for a few days, when the desired result was invariably produced.

To exhibit, if possible, the degree to which oxidation of the metal contributed to susceptibility of magnetic influence, as indicated by the testing apparatus just described, three soft steel wires of the same length, and nearly, although not quite, of the same diameter, one of which was brightly polished on the surface, another partially, and a third wholly oxidated, were placed in turn before the needle at the constant distance of three-quarters of an inch, and the duration of oscillations observed before and after exposure, with the results shewn in the annexed Table:—

TABLE XII.

Shewing Duration of Oscillations of Testing Needle, with Wires in different degrees of oxidation in front, before and after exposure.

No. of Exp.	Date of Exp.	Hour of Exp.		Length of Wires.	Diam. of Wires.	Temp		No. of Oscill	Dur of Oscill of pol. wire before Expos	Dur. of Oscill. with pol. wire after Expos.	Dur. of Os. with partially Ox wire before Expos.	Dur. of Oscill. with partially Ox. wire after Expos.	Dur. of Oscill with wholly Ox. wire before Expos.	Dur. of Oscill. with wholly Ox wire after Expos.
		A. M.	P. M.			Before Exp.	During Exp.							
1	Feb 5th.	10½	½	In. 2	Pol. W. 0.05	59°	92°	10	77	78	80	80	82	82
2	...	...	...	...	P. Ox. W 0 033	...	...	10	77	78	80	80	81	82
3	...	...	...	...	W. O. W 0.031	...	...	10	77	78	80	80	81	82
4	...	...	...	...	...	...	...	10	78	78	80	80	81	82
...	...	...	...	...	...	...	...	10	77	78	80	80	81	82
						Sums.	...	50	386	390	400	400	407	410
						Means.	...	1	7.72	7.80	8.00	8 00	8.14	8.20

From the above results it is evident, that no increase of intensity had taken place during two hours' exposure to a

very powerful sun, the glare of light being on this occasion very great, and the sky perfectly cloudless. I therefore feel warranted in asserting, that the sun's light cannot communicate magnetism to steel needles having oxidated surfaces.

There is, however, a peculiar distribution of oxidation, combined with polish, which existing in steel wires, has been considered capable of insuring their magnetization by solar light, and this is when oxidated and polished portions alternate along the length of a wire. By employing wires in this state, Mr. Baumgartner found, that after exposure, they exhibited a south pole at each polished, and a north pole at each oxidated part. In attempting to verify these results, MM. Moser and Reiss failed completely, and could produce no such effects. The point, therefore, requires farther investigation, and I proceed to give the results of my experiments upon it.

The magnetic testing apparatus formerly described was employed throughout, and in the first series of experiments, the vibrations of the needle were counted, while no wire was in front, and then when the wire that had been exposed in the meanwhile, was placed before it. The wire was placed at a constant distance of one inch outside the glass cylinder.

TABLE XIII.

Shewing Duration of Oscillations of testing Needle, without and with steel wire in front, before and after exposure.

No. of Exp.	Date of Exp.	Hour of Exp. A. M.	Hour of Exp. P. M.	Temp. Before Exp.	Temp. After Exp.	Diam. of Wire.	Hts. of Wire.	Ocid. or Polished.	No. of Osc.	Dur. of Osc. without Wire.	Dur. of Osc. with Wire.	Remarks.
	Feb.					In.	In.					
1	1	12	1	63°	88°	0.05	$\frac{7}{8}$	Ox.	10	76	72	
2	...	...	...	...	...	...	$1\frac{4}{8}$	Pol.	10	75	70	
3	...	...	...	...	...	...	$2\frac{5}{8}$	Ox.	10	76	70	
4	...	...	...	...	...	...	$3\frac{2}{8}$	Pol.	10	76	71	
5	...	...	...	...	...	...	$4\frac{2}{8}$	Ox.	10	75	70	
6	...	...	...	...	...	...	$5\frac{3}{8}$	Pol.	10	76	70	
7	...	...	...	...	...	...	$6\frac{5}{8}$	Ox.	10	76	70	

A glance at the two concluding columns of this Table will shew a very decided magnetic effect due to the presence of the steel wire, to the extent of from 5 to 6 seconds of increase of intensity in the time of performing ten oscillations. Accordingly, on approximating the wire to the unmagnetic testing needle, immediate, though certainly not very strong, attraction between the two was exhibited, the needle freely following the wire through considerable arcs, and by applying the magnetic testing needle, it was found that each oxidated part had become a north, each polished part, a south pole. This distribution of the polar forces, is precisely the converse of that obtained by Baumgartner, but is conformable to some of the cases observed by Moser and Reiss. In using the magnetic needle as a means of discovering the kind of magnetism that may be resident in any part of a magnetised body, it is only necessary to bear in mind, that like poles repel, unlike poles attract each other. In the present instance it was observed, that on approaching the north pole of the testing needle to the oxidated parts of the wire immediate repulsion was manifested, indicating the presence of polarity like in kind to itself, while on approaching it to the polished parts, attraction ensued, shewing unlike, or southern polarity.

While these results indicate with perfect clearness the truly magnetic condition of the steel wire, there are certain points now to be mentioned, which make it exceedingly doubtful whether this was due to the action of solar light. The method of observation employed was, in the first place, objectionable, as it does not shew the condition of the wire previous to exposure, a point of most essential importance, since its having been left undetermined, renders it doubtful how much of the effect on the testing needle was really due to the exposure of the wire, how much to the previous state of the wire itself. It was further found that during exposure, the wire had been inadvertently placed in the magnetic

meridian, and inclined in a direction approximating to that of magnetic dip, thus being in the very position of all others most favourable for being influenced by the inductive action of the magnetism of the earth, and consequently for becoming a magnet itself. This is a very essential point to be borne in mind, and in a subsequent section of this paper I shall have to point out how it has in all probability so influenced the results obtained by Mrs. Somerville and others, as to make it at least doubtful whether it has not led them astray, by being the unrecognized cause of those effects attributed by them to the action of light. The circumstances I have just alluded to, rendered it essential to repeat the experiments which appeared to favour the idea of the magnetic action of light, and the same wire was re-exposed, under proper precautions, its previous state being clearly determined by the observations in the last column of Table XIII: it was however determined anew to be certain against any intermediate changes.

TABLE XIV.

Shewing Duration of Oscillations of Testing Needle, with steel wire in front, before and after exposure of the latter.

No. of Exp.	Date of Exp.	Hours of Exp. A. M.	Hours of Exp. P. M.	Temp. Before Exp.	Temp. After Exp	Diam. of Wire.	Hts. of Wire.	Oxid. or Pol.	No. of Osc.	Dur. of Osc. before Exp.	Dur. of Osc. after Exp.	Remarks.
	Feb.					In.	In.					
1	2	10 to	...	6°	93°	0.05	$\frac{7}{8}$	Ox.	10	69	70	
2	...	11½	...	...	...	...	$1\frac{2}{8}$	Pol.	10	70	70	
3	...	...	...	...	...	...	$2\frac{5}{8}$	Ox.	10	70	70	
4	...	...	...	...	...	...	$3\frac{2}{8}$	Pol.	10	70	70	
5	...	...	...	...	...	...	$4\frac{2}{8}$	Ox.	10	70	71	
6	...	...	...	...	...	...	$5\frac{3}{8}$	Pol.	10	70	70	
7	...	...	...	...	...	...	$6\frac{5}{8}$	Ox.	10	70	71	

From this Table it accordingly appears, that no increase whatever took place in the intensity of the wire after farther exposure, and it may therefore with safety be inferred, that such exposure was not originally the cause of the magnetic phenomena it displayed, but that these were due, in all probability, to the influence of the magnetism of the earth upon it. The results in Table XIII. possess considerable interest, however, because they prove clearly the susceptibility of the testing apparatus to small changes of magnetic condition, and therefore justify us in placing considerable confidence in its indications, while they farther shew how important the interference of terrestrial magnetism with such experiments may be. I do not feel competent to offer any explanation of the causes of the peculiar distribution of the magnetism throughout the wire; but that the oxidated and polished parts are invariably in opposite states, although these states are not always of the same *kind*, is a remark confirmed by all the observations that as yet have been made on the point. The following Table exhibits the results obtained with steel wires, in which the polished portions were roughly finished, and not ground smooth, as in former instances.

TABLE XV.

Shewing the Duration of Oscillations of Testing Needle, with roughly polished and oxidated steel wire in front, before and after exposure.

No. of Exp.	Date of Exp.	Hours of Exp. A. M.	Hours of Exp. P. M.	Temp. Before Exp.	Temp. After Exp.	Diam. of Wire.	Hts. of Wire.	Ox. or Pol.	No. of Oscill.	Dur. of Os. before Exp.	Dur. of Os. after Exp.	Remarks.
	Feb.					In.	In.					
1	5th	12	2	61°	79°	0·05	1	Ox.	10	63	63	
2	...	...	...	...	...	...	2	Pol.	10	71	73	
3	...	...	...	...	...	...	3	Ox.	10	81	85	
4	...	...	...	...	...	...	4	Pol.	10	96	96	

Wires prepared as the above, do not therefore give results more favourable to the theory of the magnetic action of

light than we formerly obtained. There is, however, one point of difference between the last Table and those shewing the action of the wires having smooth polished surfaces, somewhat anomalous in its character; and that is, that while in the former case, increase of height of the wire produces a perceptible effect in increasing the duration of the oscillations of the testing needle, in the latter it appears to be perfectly indifferent to such increase, the times continuing the same while the heights vary from $\frac{7}{8}$th of an inch to $6\frac{5}{8}$th inches. From Table xv. it appears, that while the height of the wire varied from one to four inches, the durations of oscillation exhibited a difference between the first and fourth observation, of no less than thirty-three seconds in the time of performing ten vibrations.

Soft iron being more susceptible of magnetic influence than steel, although less capable of retaining it permanently, it appeared not unlikely that by employing it, the action of the sun's light might become apparent, while by speedily submitting it to the proper test, the acquired magnetism would not have time to dissipate itself, and would accordingly be recognised by the testing needles. Under this impression, the following experiments were made, the iron wires having each alternate inch roughly polished, the intervening one being perfectly oxidated on the surface.

TABLE XVI.

Shewing Duration of Oscillations of Testing Needle, with soft iron wire in front, before and after exposure.

No. of Exp.	Date. of Exp.	Hours of Expos. A. M	Hours of Expos. P.M.	Temp. Before Expos.	Temp. After Expos.	Diam. of Wires.	Hts. of Wires.	Ox. or Pol.	No. of Oscill.	Dur. of Os-cill. before Expos.	Dur. of Os-cill. after Expos.	Remarks.
	Feb					In.	In.					
1	5th.	11	1	59°	83°	0.166	1	Ox.	10	72	72	
2	..	..	..	..	..	..	2	Pol.	10	75	75	
3	..	..	..	..	..	..	3	Ox.	10	82	82	
4	..	..	..	..	..	..	4	Pol.	10	86	87	
5	..	..	..	..	..	..	5	Ox.	10	89	91	

TABLE XVII.

Shewing Duration of Oscillations of Testing Needle, with soft iron wires in front, before and after exposure.

No. of Exp.	Date of Exp.	Hours of Expos. A. M.	Hours of Expos. P. M.	Temp. Before Expos.	Temp. After Expos.	Diam. of Wire.	Hts. of Wire.	Ox. or Pol.	No. of Oscill.	Dur. of Oscill. before Expos.	Dur. of Oscill. after Expos.	Remarks.
	Feb	From.	To.			In.	In.					
1	5th.	$11\frac{1}{2}$	$1\frac{1}{2}$	59°	82°	0.031	1	Ox.	10	67	68	
2	..	..	..	..	..	—	2	Pol.	10	74	73	
3	..	..	..	..	..	—	3	Ox.	10	78	79	
4	..	..	..	..	..	—	4	Pol.	10	86	86	
5	..	..	..	..	..	—	5	Ox.	10	86	87	

Whence it appears that iron wires are not more adapted for exhibiting the magnetic action of undecomposed light than steel ones, and the general conclusion to which all the experiments detailed clearly point, is, that such action has no real existence, and that the effects attributed to it must have been due to some interfering cause capable of producing changes of magnetic condition, but unrecognised, and therefore not provided against by the observers. Having been unable to procure even the briefest statement of the details of M. Baumgartner's experiments, I cannot attempt to point out any sources of fallacy that may have vitiated their results, but of the existence of these I can entertain but little, if any, doubt, after the observations just described, which shew in the clearest manner, that when proper precaution were observed, *the magnetic condition of the steel and iron wires, under experiment, continued identically the same before and after exposure to the sun's light.*

Camp near Saharanpore,
15*th February*, 1842.

(To be continued.)

A Catalogue of the Mammalia of Assam. *By* H. WALKER, *Assistant Surgeon, Bengal Medical Service.*

QUADRUMANA.

1. Hylobates hooloc, Harlan. Assamese name, Hooloc. ...	Hooloc.
2. Semnopithecus entellus, F. Cuv.	Hoonuman.
3. Macacus Rhesus, Desm. Assamese, Lall Saunt, ...	Rhesus Monkey.
4. Macacus assamensis, M'Clelland, ...	Assam Monkey.
5. Lemur tardigradus, Linn. Assamese, Nilagi Bhundar, ...	Slow Lemur.

CHEIROPTERA.

6. Pteropus Edwardsii, Desm. ...	Edwards' Pteropus.
7. Dysopes ———, undetermined.	
8. Rhinolophus ———, undetermined.	
9. Vespertilio ———, undetermined.	

INSECTIVORA.

10. Sorex myosurus, Pallas. Assamese, Seeka, ...	Musk Shrew.
11. Talpa micrurus, Hodgson. Assamese, Ooloonooa.	Short-tailed Mole.

CARNIVORA.

12. Ursus labiatus, Blainv. Assamese and Bengalee, Bhalluk.	Thick-lipped Bear.
13. Ursus malayanus, Raffles, ...	Malay Bear.
14. Arctonyx collaris, F. Cuv. Assamese, Hunteree Borah,	Sand Hog.
15. Ailurus refulgens, F. Cuv. ...	Panda.

16. Mustela kathiah, Hodg. Assamese name, Durrup, ...	
17. Mustela flavigula, Boddaert,	Yellow-throated Martin.
18. Lutra Nair, F. Cuv. Assamese, Wood, ...	Otter.
19. Viverra zibetha, Linn. Assamese, Hagah Gendrah, ...	Zibeth Civet-cat.
20. Viverra rasse, Horsf. ...	Rasse Gennet.
21. Paradoxurus typus, F. Cuv. Assamese, Jymahl, ...	Common Paradoxure.
22. Herpestes Edwardsii, Desm. Assamese, Neool, ...	Edwards' Ichneumon.
23. Canis primævus, Hodg. Assamese, Kouang, ...	Wild Dog.
24. Canis bengalensis, Shaw, ...	Bengal Fox.
25. Canis aureus, Linn.	Jackal.
26. Hyæna vulgaris, Desm. ...	Striped Hyæna.
27. Felis tigris, Linn. Assamese, Bagh,...	Tiger.
28. Felis leopardus, Linn. Temm. Assamese, Nahar Phuttické,	Leopard.
29. Felis macroscelis, Temm. ..	Clouded Tiger.
30. Felis viverrinus, Bennet, ..	Viverrine Cat.
31. Felis bengalensis, Desm. ..	Bengal Tiger Cat.
32. Felis chaus, Guld. Assamese, Hoppa, ...	Red-eared Cat.
RODENTIA.	
33. Pteromys petaurista, Cuv. ...	Taguan Flying Squirrel.
34. Pteromys sagitta, Cuv. Assamese, Bahukek, ...	Arrow Flying Squirrel.
35. Scuirus bicolor, Sparam, ...	Javan Squirrel.
36. Scuirus hippurus, Isid. Geoff.	Red-bellied Squirrel.
37. Scuirus lokriah, Hodg. ...	
38. Scuirus lokroides, Hodg. ...	
39. Scuirus M'Clellandii, Horsf. ...	M'Clelland's Squirrel.

40.	Gerbillus indicus, Desm. ...	Indian Gerbil.
41.	Mus rattus, Linn.	Black Rat.
42.	Mus decumanus, Linn. ...	Norway Rat.
43.	Mus musculus, Linn. ...	Mouse.
44.	Hystrix cristata, Linn. Assamese, Khetelah Pohoo, ...	Crested Porcupine.
45.	Lepus ruficaudatus, Isid. Geoff. Assamese, Saha Pohoo,	Red-tailed Hare.
46.	Lepus timidus, Linn. ...	Common Hare.
47.	Lepus hispidus, Pearson, ...	
48.	Rhizomys sumatrensis, Gray. Assamese, Samboor, ...	Sumatran Bamboo Rat.
49.	Rhizomys sinensis, Gray, ...	Chinese Bamboo Rat.

EDENTATA.

50.	Manis pentadactyla, Linn. Assamese, Songooee, ...	Pangolin.

PACHYDERMATA.

51.	Elephas indicus, Cuv. Assamese and Bengalee, Hati, ...	Indian Elephant.
52.	Sus scrofa, Linn. Assamese, Gavuree, ...	Wild Boar.
53.	Rhinoceros indicus, Cuv. Assamese, Gor, ...	Indian Rhinoceros.

RUMINANTIA.

54.	Moschus moschiferus, Linn. Assamese, Gan Pohoo, ...	Musk Deer.
55.	Cervus Duvaucelii, Cuv. Assamese, Bhelingee Pohoo, ...	Duvaucel's Deer.
56.	Cervus porcinus, Zimm. Assamese, Kojela Hern, ...	Hog Deer.
57.	Cervus pumilio, Ham. Smith,	Dwarf Axis.
58.	Cervus Aristotelis, Cuv. Assamese, Khat-khowah Pohoo, ...	Sambur.
59.	Cervus muntjac, Gmel. Assamese, Hoogeree, ...	Muntjac.

60. Antelope cervicapra, Pall. ...	Indian Antelope.
61. Antelope ghoral, Hardw. Assamese, Deo Chagul, ...	Ghoral Antelope.
62. Capra hircus, Linn. Assamese, Sagolee, ...	Goat.
63. Bos taurus, Linn. var. Indicus. Assamese, Ghooroo, ...	Indian Ox.
64. Bos bubalus, Linn. Assamese and Bengalee, Mahees,	Buffaloe.
65. Bos gavæus, Smith. Assamese, Bunnooréa Ghooroo,...	Gyal.
66. Bos grunniens, Linn. ...	Yâk.

CETACEA.

67. Platanista gangeteca, Roxb.	Gangetic Platanist.*

Notice of the Ursus Isabellinus, HORSFIELD.

In the 15th volume of the Transactions of the Linnæan Society, is a notice of a new species of Bear by Dr. Horsfield, founded on a mutilated skin from Nipal. Dr. Horsfield named it Ursus Isabellinus. It does not appear that any further notice of the animal has been published since Dr. Horsfield's paper, which was read to the Linnæan Society, in June 1826. The following additional particulars are derived from a living specimen now in the hands of a juggler in the neighbourhood of Calcutta. It is said to be four years old, is quite tame, and has been in the possession of its present owner three years. The man says it has not arrived at its full growth, and he has seen others

* The above Catalogue is founded on 324 Specimens of Mammalia, collected in Assam in 1840-1. For the greater part of this collection, I am indebted to the kindness of the Civil and Military Officers in Assam, especially Major Jenkins, Agent to the Governor General; Majors Simonds and Davidson; Captains Vetch, Wemyss, Bigge, and Eld; Lieut. Reynolds; and Messrs. Bedford, Hudson, and Robinson.

upwards of three feet high at the shoulder in Cashmere, where they are numerous, and all of the same colour as the present animal. It is a female.

Measurements.	*Feet.*	*Inch.*
From the tip of the nose to the root of the tail,	4	0
Tail, including terminal hairs, ...	0	4
Head, from the tip of the nose to occiput, ...	1	0
Ditto from ditto, to internal angle of eye, ...	0	4½
Height at shoulder, ...	2	7
Ditto at haunches, ...	2	6
Length of ears, ...	0	4
Ditto ditto, with terminal hairs, ...	0	5
Circumference of the extremity of the muzzle,	0	7½
Ditto of the head at the occiput, ...	1	3½
Ditto of the trunk midway between the exterior and posterior extremities, ...	2	4

The colour is dirty yellowish white, assuming a darker shade with a slight tinge of red on the head, neck, limbs, and along the middle line of the back. A white mark is seen on the chest, of the form of a Y, the forked extremities of which pass up in front of the shoulders as high as to a point opposite the base of the ears. The hair on the upper and under-lips is also whiter than that on the rest of the body. The fur is of moderate length, being shorter than that of Ursus labiatus; but much longer than that of Ursus Malyanus. It is of a soft woolly texture, and more or less matted. The hind feet, and the anterior extremities from the thighs downwards, are covered with hair of a more bristly character. The base of the head is not surrounded with a mass of long hair as in Ursus labiatus. The claws, or the fore-feet are elongated, considerably curved, compressed, convex above, grooved beneath. The longest claw is three and a half inches in length, about three quarter inch in depth at the root, and about three lines in thickness. The claws on

the hind feet are much shorter and less curved, the longest is one and a quarter inches. The head is conical, broad at the base, and quickly narrowing towards the muzzle, which is truncated. The forehead is nearly on a line with the nose, the slight elevation of the former arising in part from the character of the fur which is short, and smooth on the muzzle, and thicker and longer on the forehead. The under-lip is shorter than the upper, and is overhung by the latter, so as almost to be concealed by it when the mouth is shut. The eyes are small, and situated nearly midwav between the extremity of the muzzle, and the root of the ears. Irides brown. The ears are large, rising three and a half inches above the outline of the head. There are a few short vibrissæ on the upper and under-lips. The front teeth have been extracted. There are three molars on each side above and two below, so far as can be ascertained from an imperfect view of the interior of the mouth at some paces distance. The neck is short and thick, the body robust, the limbs short and stout. The outline of the back presents a considerable eminence opposite the shoulders, behind which it is nearly horizontal, with a slight elevation opposite the haunches. There is no mane as in Ursus Syriacus. There are two pectoral, and two ventral teats.

H. W.

Muscologia Intineris Assamici; or a Description of Mosses collected during the Journey of the Assam Deputation, in the years 1835 *and* 1836. *By* W. Griffith, Esq. *Assist. Surgeon, Madras Estabt.*

(Continued from page 75, vol. iii.)

Daltonia, Hook et Tayl. Musc. Britt. 138 *partim. Bridel Bryol Univ. 2. 255.*

1. *Daltonia marginata,* Griff.

Foliis oblongo-anceolatis marginibus fibrosis, seta apicem versus scabrella, capsula cum apophyse obovata inclinata.

Hab : In arboribus in Pinetis Moflong.

Museus pusillus, elegans, Caules subsimplices apice innovantes, ascendentes, vix trilineates.

Folia rafione plantæ magna siccatione tortilia, humore patentia vel ascendentia, acuminata, plicato-carinata, integerrima, marginibus fibrosis diaphanis incrassatis, vena crassiuscula infra apicem evanida donata; areolæ parvæ rotundatæ oblongæve.

F. Perichætialea pauca, subquina, minima, evenia, intergra, concava vel convoluto-coneava, exteriora lanceolato, ovata, acuminata, marginata, interiora subrotunda, brevissime apiculata, obsolete marginata.

Seta axillaris, crassiuscula, subbilinealis, rubro brunnea, apicem versus scabra et in apophysin brevem incrassata, cæterum pertotam longitudinem sublente fortiter augente minutissime scabrella.

Vaginula subcylindracea, arcta, rubro brunnea.

Paraphyses paucissimæ. Pistilla pauca longiuscule stipitata. Antheræ quas semel solum vidi pluris 5-7 ovatæ, mediocriter stipitatæ, celluloso-areolatæ, brunneæ.

Capsula cum apophyse sicca ovata, madida obovata vel obovato, pyriformis, situ fere horizontalis, æqualis, exannulata, saturate rubro-brunnea, sublente modice augente areolis oblongis quadratisve reticulata.

Membrana interna leviter adnata, subsessilis.

Peristomium exterius lutescenti-albidum, capsulam ipsam subæquans, humore demum arcte reflexile, e dentibus 16, subulato setaceis, lata trabeculatis, linea longitudinale obsolete notatis, punctulato-opacis scabrellisque.

Interius e ciliis totidem alternantibus paullo brevioribus, suberectis, binatim compositis, punctulato-opacis, scabrellis, basin versus sæpe obsolete et minutissime perforatis, et imâ basi unitis in membranam brevissimam dentium peristomii exterioris basibus arcte cohærentem.

Columella inclusa, breviter apiculata. Sporula in acervulo viridia, immersa globosa lævia, diaphana.

Operculum conico-subulatum, rostro acuto recto, capsulam cum apophyse sub-æquans, brunnescenti-aureum.

Calyptra mitræformis campanulato-conica, basi (demum) fissa, pilis simplicibus longis acutis pallide stramineis hyalinis fimbriata, obsolete (madida saltem) reticulata, basi lutescens rostro sanguineo brunneo vel atrato.

Character generis in Muscol. Britt. loc. cit erroneus, præsertim quoad D. heteromallam, quæcus species neckeræ cujus peristomii interioris membrana basilaris, quamvis brevis, facile demonstratur. Dubitare igitur licet de genere Anomodon ejusdem libelli.

PLEUROPUS, GRIFF.

Seta lateralis. Per: ext: e dentibus 16. Interius e membrana alta divisa in cilia totidem alternantia irregularia, obsolete carinata. Calyptra dimidiata.

Musci arbosei repentes. Folia undique imbricata, acuminata, venatione varia. Flores monoici (an in omnibus) Capsula in species unica inæquilateralis.

Genus medium inter Neckeram et Leskiam, a priori apicem membrana basilari alta, a posteriori ciliis irregularibus obsolete carinatis distinguendum.

Pleuropus densus, Griff. t. xvii.

Folis lanceolatis acuminatissimis concavis integerrimis aveniis, capsula ovata, operculo brevirostro curvato.

Hab: In Pinetis Moflong.

Cæspilosus, luteo-nitens. Caules repentes, remossimi, ramis ascendentibus, sæpe fasciculatis, apicem versus pinnatim dispositis.

Folia siccatione adpressa, humore patentia dense imbricata, basi utrinque conspicue areolata cellulis magnis quadratis, areolis reliquis angustis. Flores monoici; masculi laterales sæpius setæ basi approximatæ, gemmiformes. Fol. perigonialia cordato-acuminata, integra, avena. Paraphyses nullæ Antheræ plures breviter stipitatæ oblongo-ovatæ apice coarctatæ (an semper) areolatæ.

F. Perichætialia ovato-oblonga, acuminatissima, recta avenea medum supra minute denticulata, bases versus laxe areolata.

Seta lateralis, rubro-sanguinea, fere uncialis, sicca tortilis flexuosaque.

Vaginula oblongo-conica, paraphysibus subexpers. Pistilla plura.

Capsula erecta, æqualis, rubro-brunnea, exannulata, exapophysata.

Peristomium exterius humore connivens; dentes 16 primo perparia cohærentes, cito discreti, plano subulati, solidi, creberrime trabeculati, lineâ longitudinale inconspicuâ, rigidi, opaciusculi, lutescentes.

Interius e membrana breviuscula areolata, solida, sedecies plicata, dentibus peristomii. Exterioris alternantibus exeuntibus in dentes totidem plicatocarinatos, irregulares, breves, solidos, obtusos, sinubus nudi vel denticulum gerentibus.

Columella cylindraceo-clavata, apiculata, inclusa.

Sporula majuscula, lævia, fusco brunnea, immersa opaciuscula.

Operculum e basi conica, breviter curviatemque rostratum.

Calyptra dimidiata lævis, apice atrata.

2. *Pleuropus fenestratus*, Griff. t. xviii.

Foliis e basi cordato lanceolata acuminissimis planis serrulatis mediatenus 1 veniis, capsula cylindraceo-ovata, peristomii interioris membrana fenestrata pertusa, operculo longirostro.

Hab: In arboribus Mumbree et Myrung.—Cæpitosus. Caules repentes, ramosi, ramis ascendentibus simplicibus sæpuisve pluries ramosis, apicibus (saltem siccitate) incurvis. Folia undique imbricata, ascendenti-patentia, marginibus simplicibus basi subrecurvis, acumine semitorto magis serrulato, prædita vena tenui medium paullo supra evanida. Arcolæ oblongæ, angustissimæ conformes.

F. Perichætialia lanceolato-oblonga, concava, longe cuspidato-acuminata, acumine patenti recurvate denticulato, evenia vel interiora interdum obsolete 1 venia.

Seta axillaris, rubro-nitens, vix uncialis, sicca valde tortiesu. Vaginula, mediocris.

Paraphyses plures filiformes, hyalinæ interdum copiosissimæ. Pistilla plura.

Capsula erecta, æqualis, basi obsolete apophysata, annulata, rubro-brunnea.

Membrana interna distincta, sessilis.

Peristomium exterius e dentibus 16, plano-subulatis, mediocribus fragilibus, rigidis linea longitudinali inconspicua notatis, trabeculis, conventibus humore, siccitate patentissimis.

Interius e membrana areolata altiuscula, membrana speciei precedentis duplo longiore, sedicies plicata, punctulata, irregulariter-perforata, plicis exeuntibus in cilias setacea, fragillima, longitudine fere dentium p. exterioris, subcarinatis opacis, ciliolis brevibus interdum dentiformibus, persistentioribus, solitarus binisve intersectis.

Sporula globosa, lævia, immersa opaciuscula.

Columella cylindracea, apiculata, inclusa operculum e basi conicâ longe et oblique rostratum, capsulam subæquans.

Calyptra dimidiata, lævis, cum operculo decedens.

Cilia p. interioris fugacia, sunt, cave ne cum his ciliola persistentiora confundas. An separandus ob membranam p. interioris perforatam, characterem insolitum, et cilia longa magis evoluta.

3. *Pleuropus pterogonioides*, Griff. t. xx.

Foliis ovatis valde concavis acuminatis integerrimis avenies, capsula cylindracea inclinata, peristomiorum dentibus cohærentibus.

Hab: In arboribus in Pinetis Moflong.

Caspitosus, aureo-nitens. Caulis repens, vage ramosus. Rami sæpius divisi, ascendentis apicibus prasertim siccitate incurvi.

Folia undique dense imbricata, patentia valde concava acuminata in apiculum breviusculum interdum semitortum, avenia, interdum basi obsolete bistreata marginibus subrecurvis integerrimis, Areolæ angustissimæ, basilares imæ utrinque laxæ quadratæ.

F. Perichætialia exteriora lanceolata, acuminata, interiora multo majora, acuminatissima, apicibus imis scabrellis diaphanis.

Seta unciam excedens, gracilis, apice incrassata, fusco-aurea, siccatate leviter tortilis. Vaginula elongata cylindracea.

Paraphyses copiosæ, filiformes, hyalinæ. Pistilla pauca.

Capsula cylindracea, sæpius inæqualis, grisea, inconspicue areolata.

Peristomium exterius e dentibus 16, subulatis, siccitate inflexilibus, humore erectiusculis albidis obtusis crebre trabeculatis, marginibus, diaphanis conspicuis, lineâ longitudinali inconspicua notatis.

Interius e membrana areolata, breviuscula, tenuissima, fragillima, cellulis componentibus facillime solubilibus albida sedecies plicata, plicis exeuntibus in dentes carinatas solidos cum dentibus peristomii exterioris arcte cohærentibus subæquantibus, marginibus irregularibus, vel repandis vel grosse dentatis.

Collumella inclusa, apice truncata, valde dilatata.

Sporula.

Operculum calyptraque desiderata.

Habitus Pterogonii aurei, an affinis Neckeræ tenui Hooker Pterogonium Schwaege ?.

ANHYMENIUM, GRIFF.

Seta lateralis. Peristomium duplex, exterius e dentibus 16, (brevibus) interius e ciliis totidem alternantibus (maximis) carinato convolutis, basi angustatis; membrana basilari brevissima. Capsula subæqualis. Calyptra dimidiata.

Muscus Leskioideus, pusillus, dense cæspitosus. Flores monoici.

Anhymenium polycarpon, Griff. t. xvi.

Hab: In Buddleæ specie arboreâ ad marginem sylvæ. Mumbree copiose legi.

Caules repentes, ramosissimi, ramis ascendentibus, siccis clavato-cylindraceis, ramosis, rarius simplicibus.

Folia dense undique imbricata, siccitate adpressa, madida patentia, ovata, breviter acuminata, integerrima, percursa vena ultra medium paullo evanida, marginibus leviter recurvis,

areolis subconspicuis oblongis argulatis; inferiora adpressa brunneo tincta.

Flores masculi laterates, gemmiformes, setæ basi approximati, ovati.

F. Perigonialia rotundata ovatave, avenia concava, interiora majora, Paraphyses copiosæ, longitudene variæ, filiformes vel subclavatæ, hyalinæ. Antheræ oblongæ, obliquæ, apice dehiscentes, areolatæ.

Perichætialia interiora subconformia, majora acuminibus subpatulis, vena obsoleta apicem infra evanida.

Seta lateralis e basi ramorum plerumque exserta, horum fere longitudene et subtri-linealis, apicem versus curvata, rubra.

Vaginula oblongo-cylindracea, paraphysibus hyalinis filiformibus pluribus pistilisque paucis obsita.

Capsula inclinata, subobliqua, ovatocylindracea, inconspicue areolata rufobrunnea, ore integerrimo exannulato.

Membrana interna libera.

Peristomium exterius e dentibus 16, profunde intra os thecæ exsertis, inflexilibus, brevibus, latis, plano-subulatis, obtusiusculis, crebre trabeculatis, marginatisque, linea longitudinali tenui exaratis, pallide lutescentibus.

Interius e ciliis totidem maximis dentes p. exterioris triplo excedentibus, plicato-convolutis, ideoque dorso non carinatis, acutis, basi angustatis, (ambitu ideo fusiformibus) dorso (apicibus exceptis) fissis foratisque, luteo-flavescentibus, punctulato opaciusculis, basi unitis in membranam brevissimam, lutescentem, dense areolatam, sinubus nudis.

Sporula rotundato-angulata, in acervulo viridia, immersa globosa opaciuscula.

Columella subcylindracea, apiculata inclusa.

Operculum conicum, obtusum, minute mammellatum.

Calyptra dimidiata, lævis, per totam fere longitudinem fissa.

Hookeria, Smith.

1. *Hookeria Grevilleana*, Griff.

Caule decumbente simplici vel ramoso, foliis lanceolatis acuminatis acutis aveniis, capsula cylindraceo-ovata nutante,

operculo e basi convexa recte subulato, calyptra integra glabra.

Hab : In ripis et rupibus madidis.

Surureem et Mumbree.

Caulis sæpe simplex, $1\frac{1}{2}$-2 uncialis ramique (si adsunt) complanati.

Folia subquad-rifariam imbricata, antica posticaque cauli subparallela, lateralia disticha paullo obliqua, integerrima, grandia longitudine bilinealia, latitudine extrema unilinealis, marginibus simplicibus, textura quam maxime cellulosa, areolis magnis fusiformi-hexagonis.

Flores monoici : masculi axillares, gemmiformes, cincti foliis perigonialibus paucis, minutis, rotundatis, aveniis, breviter acuminatis. Paraphyses paucæ breves filiformes, hyalinæ. Antheræ 2-5.

Folia perichætialia pauca, caulinis plures minora, lanceolata, acuminata, concava avenia.

Seta axillaris, basi subgeniculata, subuncialis, crassa, rubra sicca etortilis.

Vaginula brevis. Paraphyses paucæ, hyalinæ, filiformes. Pistilla pauca.

Capsula inclinata, nutans, æqualis, conspiciuscule areolata, castaneo-rubra. Membrana interna libera, stipitata.

Peristomii exterioris dentes humore inflexiles, basi connati, plano-subulati, acuminatissimi, crebre trabeculati, linea longitudinali inconspicue notati, rubri apicibus capillaceis scabrellis hyalinis.

Interioris cum membrana interna facillime solubile ; cilia conniventia, plicato-carinata solida, apicibus capillaceis punctulatis scabrellisque, membrana basilaris, altiuscula pallide straminea, conspicue areolata ; ciliola nulla.

Sporula minutissima, in acervulo viridia, globosa, lævia, immersa, semi-diaphana.

Columella apice truncata, inclusa operculum e basi convexa longe recteque subulatum, capsula sæpius $\frac{1}{3}$ aliquando demidio brevius.

Calyptra mitræformis, conico-subulata, celluloso-areolata.

Valde affinis H. lucenti, equâ præsertim distinguitur foliis majoribus, lanceolatis, acuminatis, semperque acutis et capsula minus ovata.

2. *Hookeria obovata,* Griff.

Caule acendembente ramoso, foliis densissime imbricatis spathulato-obovatis apice rotundalis obtusissimis ultra medium univeniis marginibus fibrosis integerrimis, floribus hermaphroditis, seta scabra, capsula horizontali oblonga-obovata, calyotra scabra, basi fimbriata.

Hab: Inveni specimen unicum fructiferum inter muscos alios e Maamloo allatos.

Caulis vage ramosus, ramique ascendentes, apicibus latiores, leviter decurvati, complanatis. Folia adpresso ascendentia, vena unica infra apicem desinente prædita, cellulis maximis sub-hexagonis areolata, marginibus integerrimis e fibris fusiformibus sub-biseriatis conflatis.

Flores hermaphroditi axillares, gemmiformes.

Folia perichætiala caulinis aliquoties minora, ovata vel lanceolata acuta vel acuminata, avenia, concava, marginibus simplicia. Paraphyses nullæ. Antheræ 2 6, fuscescentes, areolatæ, cylindraceo-oblongæ. Pistilla plura centralia.

Seta semuncialis, curvata, atro-rubra, pertotam longitudinem (apice vaginula inclusa excepta) papillis simplicibus, dentiformibus albis exasperata.

Vaginula mediocris, atro-brunnea.

Capsula æqualis, basi solida, sub lente modice augente areolis quadratis hexagonisve reticulata.

Membrana interna omnino fere libera, stipitata.

Peristomii exterioris dentes subulati, acutissimi, peristomium interius paullo excedentes incurvi, utrinque trabeculati, centro linea longitudinati lutescentiata notati, pallide lutea, apicibus punctulatis.

Interioris cilia solida, acuminatissima; membranam basilarem sedecies plicatam duplo vel paullo ultra superantia.

Sporula viridia globosa.

Columella inclusa, obovata.

Calyptra (perjunior tantum visa) mitræformis conico-subulata, papillis (setæ papillis simplicibus) exasperata, basi pilis longis simplicibus fimbriata.

Operculum desideratum.

Hujus speciei perpulchræ capsulam unam tantum vidi. Flores in exemplaribus duobus examinationi subjectis hermaphroditi, quamvis vaginula exemplaris setigeri, pistilla tantum gessit.

3. *Hookeria pulchella*, Griff.

Caule ascendente ramoso; foliis obovato lanceolatis mucronato-acutis vena ultra media marginibus fibrosis integris repandis, capsula nutanti obovato-pyriformi, calyptra integra, basi fimbriata.

Hab: In rupibus madidis sylvaticis, Surureem Mumbree et Myrung.

Caulis semuncialis, raro uncialis, interdum simplex, ramique complanati.

Folia subquadrifariam imbricata, lateralia disticha, siccitati flexuosa, marginibus recurvis; areolatio densuiscula cellulis sub 6-gonis vel rotundatis.

F. Perichætialia pauca minora, lanceolata, valde acuminata, recta.

Seta axillaris, vix semuncialis, rubra, sicca tortilis.

Vaginula brevis cylindracea, rubro-brunnea, paraphyses subnullæ, pistilla perpauca.

Capsula inclinata, nutans, vel pendula, basi solida et obsolete apophysata, obovata pyriformis vel obovata.

Membrana interna adnata.

Peristomii exterioris dentes breviusculi, acuti, crebre trabeculati, linea longitudinali conspicua, lutescentes, apicibus hyalinis.

Interioris cilia acuta, dentes peristomii exterioris longitudine paullo superantia, solida, hyalina, membrana basilari mediocri, ciliolis interjectis nullis.

Sporula minutissima, globosa, lævia, in acervulo viridia, immersa hyalina.

Columella inclusa.

Operculum conico-subulatum, rostro mediocri rectiusculo, interdum perbrevi.

Calyptra mitræformis, conico-subulata, basi fimbriata.

Variat stratura, caulibus longioribus foliis plus minus oblongis, operculo brevi-rostro, et calyptra basi, villis quasi soluta.

4. *Hookeria secunda,* Griff.

Caule decumbenti, ramis ascendentibus, foliis oblongo-lanceolatis, acutis vel breviter acuminatis argute dentatis mediatenus biveniis (lateralibus falcato-secundis, capsula cylindraceo-ovata, pendula, peristomii interioris, ciliolis nullis.

Hab: Mumbree in ripis.

Rami complanati sæpius ut videtur simplices. Folia laxiuscule subquadrifariam imbricata, antica et postica adpressa, lateratia disticha obliqua, marginibus simplicibus basin versus integris, cæterm, argute dentatis prædita venis 2 sursum divergentibus medium infra vel paullo supra evanidis; areolis angustis angutatis, parietibus crassis.

Perichætialia acuminato-cuspidata, (cuspide patula denticulata) per totam vaginulam inserta, avenia, interdum obsolete bistriata.

Vaginula foliis perichætialibus nuncupata cæterum nuda.

Seta lateralis, rubra, flexuosa, unciam paullo excedens.

Capsula æqualis vel subobliqua brunnea, inconspicue areolata.

Peristomium exterius humore connivens, e dentibus 16, plano-subulatis, creberrime trabeculatis, linea longitudinali semi-pellucida notatis, opacis, rubris apicibus albidis.

Interioris membrana breviuscula; cilia acuta, solida, punctulata, ciliola interjecta nulla.

Sporula non visa.

Operculum calyptraque desiderata.

Proxima K. falcatæ, Hook. Musc. Exot. t. 54. p. 17. a qua præsertim distinguitur foliis brevite racuminatis, capsula pendula, peristomioque interiori, quod Leskioideum.

1. *Hypnum rotulatum* Hedio. Hooker.—

—Vix. Hy.

Hab: In rupibus calcareis prope speluncam Mooosmai et in rupibus areonosis Mumbree.

Folia marginata lateralia obliqua sursum irregulariter et sæp e

argute denticulata, vena ultra medium evanida accessoria lateralibus alternis tantum adjecta, æquilateralia subintegra vena excurrente prædita.

Perichætialia minora avenia concava integerrima.

Seta apice incrassata.

Capsula cylindraceo-ovata nutans aspectu cellulosa. Per. Hypni.

Cilia peristomii interioris minute perforata; ciliola interjecta irregularia.

Operculum e basi conica longe recteque subulatum capsulam excedens.

Calyptra dimidiata lævis.

Huc. referri ob verba cel. Hookeri in Musc: Exot. sub Hypno laricino, t. 35. Vix Hypopterygium rotulatum. Brid. Bryol. Univ. 2. 713.

2. *Hypnum mnioides*, Hook. Musc. Exot. p. 20. t. 77.?

Hab: In rupibus umbrosis, Churra Punjee in regione Assameia alta versus. Negrogam. Fructiferam reperi in sylva Theiferam Gubroo Purbut.

Verosimiliter species distincta ambigens inter H mnioide et spininervium, huic caule simplicii foliis angustis setaque basilari, illi foliis marginatis et carina denticulata accedens.

Habitus quo dammodo Polytrichoideus.

Color sæpius Fuscescens folia siccatione incurva, interdum obsolete tortilia.

Description of the Plates referred to in Muscologia Itineris Assamici.

Plate XVI.—Anhymenium polycarpon.

1. Plant, portion of.
2. Leaf.
3. Male flower.
4. The same leaves removed.
5. Anther.
6. Capsule.
7. Operculum.
8. Calyptra.

9. Inner membrane and peristome.
10. Tooth of the outer peristome.
11. Portion of the inner peristome and inner membrane.
12. Sporula.

Plate XVII.—Pleuropus densus.

1. Portion of the plant.
2. Cauline leaf.
3. Male flower.
4. Same leaves removed.
5. Anther.
6. Capsule with its operculum.
7. Operculum removed.
8. Calyptra.
9. Capsule.
10. Portion of capsule, outer and inner peristomes and of inner membrane.
11. Tooth of outer peristome.
12. Portion of inner peristome and membrane.
13. Sporula.

Plate XVIII.—Pleuropus fenestratus.

1. Portion of a plant.
2. Cauline leaf.

2*a*. Perichætial ditto.

3. Capsule.
4. Operculum.
5. Calyptra and operculum.
6. Inner membrane and peristome.
7. Tooth of the outer peristome.
8. Portion of inner peristome and membrane.

Plate XX.—Pleuropus pterogonioides.

1. Portion of the plant.
2. Cauline leaf.
3. Perichætial ditto.
4. Capsule.
5. Portion of capsule and outer and inner peristomes.

All more or less magnified.

Memorandum regarding Salmo Orientalis, or Bamean Trout. *By* Mr. Griffith.

Plate I is a reduced figure from an original drawing of Salmo Oriental, the species is described p. 585 of the second volume of this work, as inhabiting the tributaries of the Oxus, on the northern declivities of Hindoo Koosh. There is no fact in Natural History so characteristic of the peculiar laws to which the distribution of species is subject, as the occurrence of Salmons on the northern declivities of the Hindoo Koosh, contrasted with the equally well established fact of their absence, not merely on the southern declivities of the same chain, but also throughout the rivers of Affganisthan and India. Considered by itself, or merely with regard to temperature, latitude, longitude, and elevation, it would be quite inexplicable; but on the other hand, when viewed in relation to the well-known habits of the Salmons, it is only what might be expected. The Salmons are known to belong to the seas of temperate climates, and to enter the mouths of rivers during spring, and penetrating to their extreme tributaries, there deposit their spawn in the gravel, beyond the reach of various injuries to which it would be subject, as well as the young fry, in less remote situations. However suitable the Himalyan and other mountain streams south of the boundary just noticed might be in point of temperature, and other circumstances adapted to the development of the young Salmon, yet the tropical seas into which these waters fall would be fatal to them, so that the absence of Salmon may be easily accounted for in all countries, the rivers of which have no communication with the seas of the temperate climates. The sea is essential to the Salmon, indeed it is their natural abode, as they leave it only for the purpose of spawning. It is evident, therefore, that the Salmon must ascend the Oxus from the sea of Aral, a dis-

tance of 1,200 miles, to the place where they were discovered by Mr. Griffith, at an elevation of 11,000 feet, nearly equal to the mean elevation of the highest chain of the Alps, from Mount Blanc to Mount Rosa.

The species although named as new, may not be so, as the Salmonidæ are extremely numerous, and consequently difficult to define; it is possible, therefore, that we may be mistaken. Lacepêde, Bloch, and Yarrell are the only authors we have been able to consult on the subject, but as specimens have been sent to England with the collections of Mr. Griffith, the question may there be decided. The figure is reduced to about two-thirds of the size of the original drawing. The form of the operculum, as represented in the figure, not corresponding with that of the specimen, we have supplied Fig 1. a correct outline of this part, Fig. 4 represents the form of the intestine in *situ.* Figs. 2 and 3, the same as removed from the fish.

Mr. Griffith remarks, that it takes the worm greedily, generally gorging the hook. In sunny days, in winter, he says it takes the fly freely, although the cold is exceedingly severe. It is found, Mr. Griffith further remarks, in the streams falling into the Bamean river, from the Kohi-Baba, as high as 11,000 feet, but a few marches nearer the plains of Toorkistan at Bajgah, Mr. Griffith learned from Captain Hay that it attains a considerable size, and that the flesh is very delicately flavoured.

Memorandum regarding the predaceous habits of certain Indian Frogs, in an instance observed by T. Wright, Esq. *at Suharunpoor.*

About the end of August 1840, Mr. Wright one evening was seated on a terrace, outside of the house, and noticed one of the large yellow ram frogs of Hindostan quietly couched under a piece of timber close to the terrace. There

happened to be a quantity of chaff and grain strewed over the ground, which attracted a crowd of sparrows to the spot. The movement of the birds hopping about and pecking the grain, soon aroused the frog, which evinced its interest, by raising itself on the hind legs, and vibrating the body rapidly backwards, without breaking cover from under the timber. At length one of the sparrows came sufficiently near, when the frog in one spring of some four feet, threw itself most accurately on the bird, and seized it in an instant, taking the head, neck, and body, at once into its gape. It then sprang back to its cover, and was vigorously engaged in swallowing the bird, when Mr. Wright, who was attentively watching what was going on, pushed the frog into a corner, where he was able to seize it, and after a determined resistance compelled the reptile to disgorge its prey. The sparrow had some life remaining when drawn out.

India Review.

For a series of months past, we have been flattered by the re-appearance of articles from our pages in large editorial type in *the India Review.* Sometimes a small asterisk, and still smaller foot note indicate the source from whence they were taken, but as nothing would be easier in quoting the *India Review*, than to overlook the asterisk together with the little *ibid* to which it refers, (and which would mean nothing, unless several preceding articles, similarly appropriated, should also be quoted at the same time,) we confess it would be more satisfactory to see in full the titles of the works from which such extracts are made, inserted in italics at the end of each article. Why should an Editor be ashamed to acknowledge, freely and fully, the titles of the works from which he borrows? Where he omits to do so, or merely minces an obscure or imperfect acknowledgment, he deprives the author quoted of his right, or evinces an unwillingness to allow it, and besides introduces an uncertainty as to authorship, which is always to be avoided. In the last number of the *Review*, there is an article on Agriculture, by Mr. Griffith, the botanist, in which the author's name is altogether omitted, and the article inserted as if it were taken from Mr. Speede's Hand-Book of Gardening, which forms the preceding subject.

We have also been accustomed to see our lithographic drawings reprinted in the *India Review*, with the title of this Journal erased from them, and that of Dr. Corbyn's substituted in its place,—a practice which surely can never be sanctioned with propriety.

CAMPHOR.

With regard to the letter of Mr. O'Reiley, which we have inserted in the correspondence, we referred to Dr. Voigt of Serampore for information relative to the plant affording the Camphor, of which specimens both of the plant itself, and of the crude Camphor afforded by it, had been forwarded by Mr. O'Reiley. Regarding the plant, Dr. Voigt states, that it belongs to De Candolle's genus *Blumia*, and is, as far as he can see, a new species ; the genus however affords, Dr. Voigt remarks, several species presenting camphoraceous properties. The sample of Camphor forwarded by Mr. O'Reiley, as obtained from the plant in question, which appears to be very common on the Tenasserim Coast, we placed in the hands of the Laboratory Assistant in the Honorable Company's Dispensary, in order to have a portion of it refined, and also that the various preparations of Camphor in medical use might be prepared from it, which has been done accordingly, and the samples of the different articles obtained, have been submitted, through the proper channel, to the Medical Board.

In refining this Camphor, there is a loss of about 25 per cent. of its weight. The ordinary loss in refining China Camphor is about 19 per cent. Taking the value of the latter at 4*s.* 8*d.* per lb. in its crude state, the usual rate being for the present year 2 rupees 8 annas per lb., that of the former would be 3*s.* 9*d.*; but last year the article was obtained for 2 rupees per lb., or 11*d.* per lb. less than its cost this year, so that the Tenasserim Camphor would require to be delivered at 2*s.* 10*d.* or 1 rupee 5 annas per lb., in order to complete with the Chinese article. From

the observations of Mr. O'Reiley, the plant seems to be very abundant, and the method of manufacture both simple and efficient, so that there would not appear to be any obstacle to the article becoming an important production. In its refined form, it is identical in all its properties with Chinese Camphor.

Isinglass.

Since the remarks on Isinglass detailed in the commencement of the present number were printed, a very important observation has been made relative to the structure of the air vessel of *Polynemus Sélé*, which will lead to the perfect purity of the Isinglass, and place it on a footing with the best Russian description of the article; while the abundance in which it is afforded by this fish, cannot fail to render it an object of great importance. When examining a sample of the article received from Mr. O'Reiley of Amherst, weighing 12 lbs., and which cost on the Tenasserim Coast 4 rupees, it was found that each piece, from which the outer and inner membranes are removed, consists of an outer and an inner structure. The outer structure consists of a thin lamina composed of *oblique* fibres, which are easily seen passing diagonally over the surface, and composing about ten per cent. of the whole. If the mass be divided crosswise into narrow sections, the transverse fibres may be perfectly separated into fine silky fibres, which consist entirely of pure isinglass. Mr. Scott, the Assistant, who was employed in the examination, suggested the separate analysis of the outer oblique fibres, when it was found that they consisted entirely of *fibrin*, and contained all the impurities for which the Bengal Isinglass had hitherto been considered inferior.

Comparing one of the sections from which the oblique fibres had been removed, (No. 5 in the annexed table,) with a specimen of Isinglass received from Dr. Royle, (No. 1 in the annexed table,) and said to be very pure, the resemblance was

quite perfect, and it will be seen from the annexed table of analysis that, of the two, our own specimen is the purest, the "loss" being chiefly gelatine. The analysis has since been frequently repeated with invariably the same result.

Isinglass examined in the Laboratory of the H. C. Dispensary, April and May,* 1842.

Description.	Fibrin.	Albumen.	Gelatine.	Loss.	Total.
1. Good Isinglass, received as a sample from Dr. Royle, in a letter under date 29th Nov. 1841, ..	2.5	a trace.	97.5	none	100 parts.
2. Imported with Medical Stores for public use from Europe, 1840-41. Invoice price 18*s*. per lb. ..	2.5	a trace.	95.	2·5	100 parts.
3. Bengal Isinglass in the rough, as exported in 1839-40, and sold for 1*s*. 7*d*. per lb., inferior sample, ...	10.	a trace.	87.5	2·5	100 parts.
4. Bengal Isinglass in the rough, as exported 1839-40, and sold for 1*s*. 7*d*. per lb., favourable sample, ...	7.5	a trace.	90.	2·5	100 parts.
5. *Ditto with the outer oblique fibres peeled off.*	1.25	a trace.	95.	3·75	100 parts.

* The following is a note by Mr. Scott, the Laboratory Assistant, detailing the manner in which the examination was conducted:—

"Twenty grains of Isinglass was introduced into a mattrass with two ounces of distilled water, and dissolved over a water bath. The gelatinous solution being carefully decanted, was then evaporated to its proper consistence, and the weight ascertained. The insoluble portion was well washed, dried, and its weight noted. The presence of Albumen was detected by the solution being rendered perceptibly opaque at a boiling temperature."

Correspondence.

Extract of a Letter, from E. O'Reiley, Esq. *dated Amherst, 6th March,* 1842, *to* J. M'Clelland, *Assistant Surgeon, Calcutta.*

Camphor.

The bottle herewith sent is part of a quantity of about 120*lbs.* procured by evaporation from the tops of a plant growing most profusely throughout the jungles on this coast, (specimen in flower enclosed in the box.) The attention of a few Chinese was attracted to it some months ago, by my enquiry whether the same plant was common in China, and to what purpose it was applied. I was informed that the plant, which is an annual, was cultivated in some of the seaward provinces of China, and that the salt procured from it formed a part of their Materia Medica, being considered efficacious in cases of rheumatic pains and other diseases requiring emollients.

The whole of the apparatus employed in procuring the salt is simple in the extreme, consisting merely of a large pan into which the tops are put, with a sufficient quantity of water to cover them over, in which is placed a cylindrical casing of wood, being smallest at the top, on which is fitted a large shallow brass basin. A gradual heat is then applied, and the steam rising through the casing is condensed on the surface of the basin, which being constantly supplied with cold water, causes a crystallization of the salt; this method is so rude, that it is impossible to form any correct idea as to the proportional parts of salt in a quantity of the plants, but judging from its very strong odour when rubbed between the fingers, it may be supposed to contain a very much larger proportion than is procured by the method just stated; should it prove to be of any considerable value, or at all approaching to that placed on it by the Chinese who made it, the yearly produce of these jungles would amount to a very considerable item. On this head I shall be most happy to hear from you.

Isinglass.

The box contains about 12*lbs.* of this article, prepared by the method you gave sometime ago, when specimens of the fish were forwarded; this lot will enable you to form a better opinion of the article than the former specimens. I have paid 4 Rupees for the quantity now sent, to induce a greater interest being taken in it by the Burmese fishermen, and as the article obtains a footing, as being in large request, I have no doubt of being able to procure it by and bye at a considerable reduction, say at least one-third less than the price now paid.

Arrow Root.

The bottle now sent, I made two days ago from plants of one year old, which are the produce of a few plants presented to me by Dr. Wallich, when in Calcutta some time ago. The plant appears to thrive remarkably well here, and judging from the size of the bulbs, (one of which is now forwarded,) I should say it is not excelled by any grown in Bengal.*

Extract of a Letter from T. Wilkinson, Esq., *Resident at Nagpore, To* J. M'Clelland, Esq., *Secretary to the Coal Committee, Calcutta.*†

1.—I have the honor to acknowledge the receipt of your letter of the 25th ultimo, and in compliance with the wishes of the Committee, shall furnish you such information as I have been able to collect, regarding the ores and minerals found within the territories of the Rajah of Nagpore.

Minerals.

2.—In Wyragurh, about 90 miles to the south-east of the city of Nagpore, there are diamond mines. I formerly visited them with Mr. Jenkins, when he was Resident at Nagpore; the following is what he has written about them: "The diamond mines of Wyragurh were formerly celebrated, though now they do not yield sufficient returns to render them worth working. The diamonds were found in earth which forms small hills in the vicinity of Wyragurh. The spots are still distinguishable where they have been dug up. During the reign of the late Raghójée Bhonsla, the mines were worked at a considerable expense, but only a very few small diamonds of little value were found, and they are now entirely neglected."

3.—At Koraree, near Nagpore, there is much white marble found, which is capable of receiving a fine polish, it is used extensively in building. A specimen is forwarded.

4.—At Seukeindan in the Larihee Hills, there is a red ochre found in large quantities, a great deal of which is exported. The natives use it in colouring their houses, and with it is dyed the clothes worn by Gissaons and Byragees, and also Tant Putties, it sells in Nagpore at 25 seers for the rupee. A specimen is forwarded.

5.—Yellow ochre is found in the Chanda district, but in what particular villages I have not ascertained. It is used for colouring houses,

* The Arrow Root appears to be of very superior quality.—Ed.

† Presented by the Committee.

by both Europeans and Natives. It sells in the city of Nagpore at 15 seers for the rupee. A specimen is forwarded.

6.—An infer description of yellow ochre is found near Kulmeshur, about sixteen miles to the east of the city of Nagpore, it is used for the same purpose as the last mentioned, and sells in the city of Nagpore at 30 seers for the rupee.

7.—There is a fossil alkali,* which the Natives call Reh, found in large quantities near Ponar, 50 miles south-west of Nagpore. It is used by the Dhotees for washing clothes, and I believe the Natives make use of it in preparing soap.

8.—Pukan red, found at Kondallee, 30 miles to the west of the city of Nagpore, the English name of it I have not been able to ascertain; it is used in medicine by the Natives, particularly for women after child-birth. I send a specimen, and shall feel obliged by your informing me what its name is in English. It sells for 28 seers the rupee.

9.—Sungjura, or Sungi Jirahal, a species of steatite or soap-stone, used by Natives in medicine; it is not found within the Rajah's country, but I believe somewhere in the Jubbulpore territory, although the exact place I have not ascertained; I will endeavour to do so. It sells in the bazar at 10 seers for a rupee. A specimen is forwarded.

10.—Tuli is found in different parts of the country, but not good. Limestone is plentiful, but good clay for making brick is scarce. There is a small hill about five miles to the west of the Residency of basaltic columns. I am not aware of the existence of coal states, fusible earth, earth oil, or any other useful minerals besides those above-mentioned. In the event of hereafter learning that such are to be found, I will inform you.

11.—Iron ore is found at many places in the Nagpore country in large quantities; the following are the names of several villages at which it is prepared; viz. Aumgaon-oomjerrie in the Suhanghurree Pergunah, Konolie in Pertaubgurh, Lahara, Bijlee, and Porara in Lanjhee, Puttrapite in Ambagurh, Agree in Chandpore, Mendkee and Ballapore in Berhampooree, Gunjumarrah in Gurh Boree, Armorie in Wyragurh, Naotulla in Nerus, and Govindpore and Shunkerpore in Chinioor. The ore is smelted in the first instance in a furnace of the shape of a pyramid made of mud, with charcoal of such wood as may be procurable, it is afterwards removed to a smaller furnace in which charcoal of bamboos or teak is used, which completes its preparation for the market. I have procured some of the ore from Aumgaon-oomerjerrie, and send a specimen.† Steel is not manufactured from any of the ores

* A specimen is sent. It is an earth containing a small proportion of Carbonate of Soda.—Ed.

† Is sent.

of iron found in this country. At some of the places above named, a superior description of iron is prepared called by the Natives Beer, which is used for giving a finer edge to tools. I send herewith a specimen, and have sent for some of the ore from which it is made, which I will forward hereafter.

12.—Gold dust in small quantities is procurable in Jouk Nuddee, near Sonakan in Chutteesgurh, in the Mahanuddee near Rajoo in Chutteesgurh, in the Sou and Deo nuddies, in Lanjhee, and in the Marroo-nuddee in the Amborah Pergunah. A caste, called Soujerries, gain a poor livelihood by collecting the sand and washing it, and then separating the gold from the finer particles of sand by means of quicksilver. I send specimens of the gold freed from the sand, and some mixed with it.

13.—If I should hereafter make any discovery of other metals or minerals, I will report the same for the information of the Committee.

Nagpore Residency, the 22d April, 1841.

The following extracts of a letter from Bagdad can hardly fail to interest our readers,* and the information given regarding a country so little known, and which so few Europeans have ever an opportunity of visiting, must be thought valuable even by the most indifferent person :—

"During my last trip up the Euphrates to Sook-el-sook and the ruins of two Babylonian cities near it, the fearful curse pronounced upon that wicked land, was impressed most deeply upon my mind. The horrible desolation; the soil full of saltpetre; the flood from the Euphrates; and the misery and oppression everywhere exercised upon the inhabitants, all speak this most strongly. The desolation has fallen not only upon Babylon, but upon all her provinces, which extend from Anna to Bussorah. Every city was built upon a high mound of mud, bricks, and straw, raised above the level of the low land around; and these mounds are the only vestige left by which we can discern where her rich cities were; for there is not a natural hill in all Mesopotamia; not a building to be seen but these mounds, which are invariably shunned by the Arab for a distance of thirty miles; not a vestige of life or dry land is to be seen, the banks of the river having been washed away, the water has flowed over the whole face of the country converting (what was formerly so fertile,) into one vast dismal sheet of bitter water, for not a rush nor a reed will grow. So, turn which way

* We are indebted for it to Capt. Campbell of Madras, whose valuable contributions have formed so prominent a feature in our pages.—*Ed. Cal. Jour. Nat. Hist.*

you will, nothing but a painful, chilling feeling of solitude runs through the shuddering breast. The weather here (Bagdad) is bitter cold, (28th January); a sharp frost for several days having prevailed, which is an extraordinary change from the heat of summer. Here, however, a real winter is seen. Trees and shrubs all bare, the ground covered with frost, and *one day we had snow.* We had ice lying in our court-yard for two days; the sun did not melt it.

I will now give you an account of our trip to Anna. We reached the banks of that noble river, the Euphrates, at Felugia, from thence we went to Hit, celebrated for its bitumen springs, of which there are seven, but two only are made use of, the bitumen from the rest streaming down the sides of the hills, where it congeals. This is the Hit of Scripture, and was one of the Babylonian cities destroyed. From this we reached Anna in three days, and returned by about morning, with the current at about three miles an hour. Anna is a most delightful place, the people are rosy-cheeked, active, and happy, compared with other places. The females are fair and pretty, and the whole place seemed cheerful. Fine gardens of the olive, apple, pear, and orange mingled with the date occur on the river side, watered by picturesque old ivy or moss-covered aqueducts, into which the water is raised about thirty feet by huge rudely made wheels of thirty-five feet diameter, turned slowly and groaningly by the force of the current into which the lower rim dips. A number of little pots fixed round the rim of the wheel, fill as they dip into the water, and are emptied into wooden troughs at the top. These rude, but effective machines, are found in great number all along the river to Hit, below which there being no stone or lime (to build the aqueducts or dams), the water is drawn by cattle, the same as in India. At Anna I visited a spot pointed out as where Imaum Alli, cousin of Mahomed, stamped in anger, and indented the rock with his foot. There is certainly a mark, but it required much imagination to suppose it like a foot-print. (This must be something like the cavities left in the granite rocks of South India by the decay of nests of embedded hornblende, by which every desirable locality is provided with a print of Ramaswamy's foot, or of the Bull Nundy's). At Anna also I visited with much more interest, the graves of four of the unfortunate crew of the *Tigris*, whose bodies were recovered and interred. Below Anna, we visited all the ancient Mahomedan ruins on the banks; now with all their signs of grandeur forgotten and almost unknown. To enumerate every one, would be useless. Between Anna and Hit, are Tiblis, Hadaisa, Abopse, and Jubuh, which were flourishing Christian Bishopricks* in the time of the Armenian church, now all in ruins and

desolation. The Arabs of the Desert being the only people met with, no man is safe who cannot carry sufficient force to intimidate those he meets, and prevent their plundering him. The wharfs, numerous corn mills, stone embankments at the bunds of the river to receive the rush of the current, the ruins of numberless aqueducts and lofty minarets, are the only signs of the past, now to be seen. Below Hit, the nature of the country alters very much from a hilly and rocky country, the stream now enters an open level country, the bank being low and formed of mould, (the alluvium of the Delta of the Euphrates here doubtless commences), and the course becomes very tortuous and winding; the rapid action of the stream on the banks causes frequent changes, by which whole towns are sometimes swept entirely away. Here the country takes an active and cheerful appearance, the natives being seen busy on the side of the river irrigating their corn fields by cattle and leather buckets, singing and responding to each other, and a stranger would little think, while he listens to their jokes and merriment, that he was passing a tribe of the greatest thieves and rascals, who for two buttons would not scruple to commit robbery and murder, and return to their buckets again with greatest *sang froid* imaginable; to us, however, they were civil enough, for they feared the strength of the party.

"Here we had an opportunity of witnessing a most pleasing sight. One evening it being quite calm, we exchanged compliments with the chief of the tribe; he expressed sincere friendship for the English, and as we left, his Moollah asked us to decide a dispute about a feast which was to commence that night or the next, but they had forgotten which. Having just come from Hit, they thought we could tell them, as they had no communication. On assuring them that the feast began that night, the Seik immediately ordered the signal to be made, on which a dozen balls of fire rose on the points of the long spears, and the men mounting galloped about, causing a most extraordinary appearance, for in a short time the country round, as far as the eye could see, appeared covered with little stars flitting about in all directions. The rest of the people commenced singing and dancing, and the watermen on the banks of the river passed rapidly the news down to each *other*, so that we found that the signal had reached Hillah the same night, a distance of 150 miles.

"From Hillah, the supposed ruins of the tower of Babel are situated seven miles distance in a S. W. direction. These remains are most admirably represented and correctly described in 'Keith on Prophecy.' The mound is now 140 feet in height, and is without question, square

and solid, so that it cannot have been a palace, nor a fort, nor a storehouse, as some imagine. It is formed of bricks cemented with a kind of slime peculiar to the 'Birs,' as it is called; but what it is I could not exactly make out, but it did not seem to be bitumen. Huge masses of brick lay scattered one upon another, as from the explosion of a vast mine. Every mass, even of ten feet in diameter, is vitrified to the very centre, though the form of the bricks can still be distinctly seen, shewing the effects of a degree of heat far beyond the power of man to produce, and pointing out in the most striking manner, the effect of that Almighty power, which has effected the destruction. Having taken a hasty view of the city of Hillah, which is entirely built of the bricks from the tower of Babel, we started for the ruins of Babylon, which extend for some distance up the river. These are mounds or heaps, the first of which is called the palace of marble, from which the beautiful slabs of marble are taken and broken up for cement. Near this, the natives pointed out a large oven or furnace, partially fused like a brick kiln. This they say is the furnace into which *Daniel* was cast. It is too close to the palace to be a brick kiln, and can only have been intended for the purpose of punishment.

"A little to the north of the large hall of the palace, stands the only willow tree to be found any where in the country. It grows among the ruins, raised fifty feet at least above the level of the good soil, down to which its roots must reach, to obtain nourishment; for all these heaps of ruins are saturated with saltpetre. A little further on, is a figure of a lion standing upon a prostrate man, cut in stone, four feet high by eight feet long. Not a vestige of the city walls is to be seen, so completely have they been destroyed; but the ground for twenty miles round is strewed with bricks and pots. Not a blade of grass grows here, nor does man seek the desolate waste; save a few who live by selling bricks and antiques; beyond these heaps is a castle in which I hope to make some discoveries, but of that hereafter. To the north is the plain of Dura, where the golden image was set up."

Extract of a Letter from Dr. Boase, late Secretary to the Royal Geological Society of Cornwall. Presented by Captain Campbell of Madras.

The following may be interesting to those who have had an opportunity of perusing Dr. Boase's excellent work on Primary Geology, and I think that there are few who have studied that work, and have had opportunities of comparing his perspicuous and admirably correct descriptions with the phenomena of nature, who will not regret to learn, that the author is no longer engaged in scientific pursuits, but

has been obliged to devote his time to commercial affairs. I may be allowed to record my regret on learning this, for I had looked forward to the publication of a revised and improved edition of a work, which is beyond doubt the most useful of any with which I am acquainted.

It is gratifying to learn, however, that although the opinions regarding Geological phenomena, which Dr. Boase has assumed from his own observations are totally at variance with the opinions generally received, and the current theories, and if proved by future research to be correct, will tend to overturn all existing systems, yet his labours have been well appreciated by the Geological Society, who have paid him the flattering compliment of electing him a member of their Council; a compliment the more gratifying, as it was entirely unexpected on Dr. Boase's part.

It is singular, that the information of the discoveries by Sedgwicke and Murchison should have reached us just about the time of the discoveries by Messrs. Kaye and Cunliffe at Sydrapettah, for from my knowledge of the Geology of the country lying to the west of this locality, I consider it most probable, that like the Dartmoor formation, the fossiliferous beds are superposed immediately from the granitic. Dr. Boase remarks, "You will have learnt by the reports of the Geological Society, that Sedgwicke and Murchison have traced the fossiliferous strata to the immediate vicinity of the granite of Dartmoor; they assert even to the very contact therewith, and traversed by granite veins. I should have liked to investigate this point, but had no opportunity before leaving the West of England. That the strata with organic remains may approach very near to, and even overlap the granite, is well known; and it would not be easy to trace the line of demarcation between them and the primary slates, should any here intervene, because the one being formed of the detritus of the other, and being of so old a formation, would be perfectly consolidated, and exhibit the same lines of structure. Now, if true granite veins, that is, elongations of the same mass of granite intersect the strata, and pass into or shew a similar mineral composition, then it is evident that the strata adjacent to the granite are primary according to my views, that is, contemporaneous with the granite."

Dr. Boase considers the crystalline schists and argillaceous slate not to be of sedimentary origin, but to be mechanical modifications of primary rocks, and that they are not stratified. An opinion which I consider to be corroborated by my own observation, and which I had entertained and explained to a friend at Hoonsoor, long before I met

with Dr. Boase's work. "If my theory be correct, then the strata so traversed by granite veins are not fossiliferous, but will be found at some point to be distinct." Dr. Boase denies the generally received fact, of the supposed graduation of fossiliferous formations into the primary schists. If, on the other hand, it be substantiated that the very same beds with organic remains reach the granite, and at the parts adjoining are metamorphised by the action of heat, then I am in error.

Dr. Boase doubts the correctness of the assertion, that rocks are metamorphised by the action of heat when in contact with what are called "igneous rocks," and he remarks, (Primary Geology, page 306,) "Admitting these changes to have been produced by the action of in- "tensely heated trap rocks, how comes it to pass that a like cause "has not produced a corresponding effect; how is it if these rocks have "been intruded among the strata in a state of ignition, that they have "not equally altered the same rock throughout their entire course?

I have alluded in several parts of my book, more particularly in the last chapter, but more explicitly in the Annals of Philosophy, to a way in which the generally received theory and mine may be reconciled. Suppose my general views to prove erroneous, as in the above instance, then I must admit that primary crystalline schists are only secondary strata, changed by the action of heat; but in so doing I contend, that granite itself is in the same predicament; that is, that the whole of the primary rocks have then resulted by the action of fire on fossiliferous strata. It may come to this, but in the mean time, the facts are not sufficient to justify "our jumping at such a conclusion."

Upon the investigation of the points on which Dr. Boase remarks, I do not find that we have any published information as yet from the examination of the vast primary formations of South India. The only notice I am able to find, is a remark by Dr. Malcolmson, (*Journal of the Asiatic Society of Bengal*, No. 50,) where he remarks, that between Hydrabad and Nagpore at the Meeklegandy Ghaut "limestone containing shells was observed lying upon granite of a reddish colour;" but the observation is very imperfect, as it does not appear whether the rock was part of an extensive granitic formation, or only a portion of one of the granitic beds occurring in what I have termed the "schistose series;" neither does it appear, that Dr. Malcolmson endeavoured to observe, whether the fossiliferous bed was traversed by veins from the granite, or whether it was metamorphised in any way, or changed in appearance or mode of aggregation, by association with the bed of granite.

Miscellaneous.

On the Principles of Electro-Magnetical Machines, by Professor Jacobi, *of St. Petersburgh.**

"I have the honour to present to the British Association an historical sketch of the laws which regulate the action of Electro-Magnetic Machines, laws which will enable us to determine in a precise manner the important question, of the application of this remarkable force as a moving power. Since the commencement of my labours, which had partly a purely practical tendency, I proposed to myself to fill up as much as possible the blank which still remained in our knowledge of electro-magnetism. With the assistance of M. Lenz, I prosecuted the labours, which were the more arduous as they had but few precedents in the direction which I considered it necessary to follow, and we began to examine carefully the laws of electro-magnets. The report, which contains the results of our researches, was read in June 1838, before the Academy of Sciences, at St. Petersburgh, I take the liberty of repeating here very briefly, the contents of this first report. The problem which we sought to determine may be stated as follows: If a nucleus of malleable iron and a voltaic battery of a certain surface is given, into what number of elements should this surface be divided? what should be the thickness of the wire of the helix which surrounds the nucleus? and, lastly, what number of turns should this helix have, in order to produce the greatest amount of magnetism? I will not dilate here upon the manner in which we have proceeded, or upon the degree of certainty which belongs to the laws established according to our observations. I take the liberty of appending to this statement the report in question, and will proceed to explain the particular laws: 1st. The amount of magnetism engendered in malleable iron by galvanic currents, is in proportion to the force of these currents. 2ndly. The thickness of the wire twisted into a helix, and surrounding a rod of iron, is absolutely of no consequence, provided that the helix have the same number of turns, and the current be of the same force. This law extends also to the case in which ribbons of copper are employed instead of wire. Nevertheless I must notice, that in order to obtain a current of equal force, it is necessary to employ a voltaic apparatus of greater force, if small wires which offer a greater resistance are

* These observations are referred to, by Dr. Taylor the translator of the account of an electro-magnetic engine reprinted in our last number, vide, p. 119.

employed. 3rdly. If the current remain the same, the influence which the diameter of the helix exercises may be neglected in the majority of practical cases. 4thly. The total action of the electro-magnetic helix upon the rod of iron, is equal to the sum of the effects produced by each coil separately. Adopting these laws, and submitting them to calculation according to the formula of M. Ohm, the importance of which formula was but lately begun to be appreciated by some British philosophers, we have established the formula which contains all the particular conditions required to obtain the maximum amount of magnetism, which may be expressed in the following extremely simple manner; viz. *the maximum of magnetism is always obtained when the total resistance of the conducting wire, which forms the helix, is equal to the total resistance of the pile.* On referring to the remarkable law of the definite action of the galvanic current, established by Mr. Faraday, it is found that the magnetism of malleable iron divided by the consumption of zinc,—a quantity which we have called economic effect, is with reference to the maximum of this magnetism, a constant, or an expression into which neither the thickness of the wire nor the number of the elements into which the total given surface of the battery is divided enters, but only the total thickness of the envelope.

"Having finished these first researches, and having obtained these results, which were highly satisfactory, not only for their simplicity, but also for their practical value, we set about extending our inquiries to iron rods of different dimensions. Is there, it may be asked, any specific effect produced by the length or thickness of the nucleus? or does the degree of magnetism solely depend upon the construction of the helix, and the force of the current? The solution of this new problem presents a greater difficulty than the problem which we had succeeded in completely solving. Now, we are obliged to take iron rods of different dimensions, and, consequently, in all probability of different qualities. Similar conditions with reference to the action of the electro-magnetic helices are likewise difficult to obtain; and we soon perceived that these circumstances rendered it impossible to attain so close an accordance, as that which we had obtained in our former observations. Although these experiments were made two years ago, the results have not yet been published, because, being occupied with other labours, we have not been able to find the necessary time for their reduction and arrangement, and for the requisite calculations. Nevertheless I take the liberty of presenting to the Section some results, which are not devoid of interest, and which are intimately connected with the question of electro-magnetic machines. We submitted nine cylinders of malleable iron, each eight

inches in length, and of different diameters, from three inches down to one-third of an inch, to the action of a voltaic current of the same force in each case, and we obtained the amount of magnetic force represented in the following table.:—

Diameter of the rods.	Magnetism observed.	Magnetism calculated.
3	447	442
$2\frac{1}{2}$	378	376
2	308	310
$1\frac{1}{2}$	246	244
1	175	178
$\frac{5}{6}$	158	156
$\frac{1}{3}$	142	135
$\frac{1}{2}$	112	113
$\frac{2}{3}$	87	91

"This calculation has been made according to the formula $m = 131.75\ d + 46.75$, in which the constants have been obtained by the method of the least squares. The differences between calculation and observation, are not so large that they cannot be attributed to the inevitable errors of observation, and to circumstances inherent in the qualities of iron, &c. A similar agreement is found between other observations, which we shall describe in the report itself. I think, therefore, we may admit the following law, namely, that the *amount of magnetism received by different iron rods of the same length, and submitted to the influence of a current of the same force, is proportional to the diameter of the rods.* I must remark, that the constant which we have added in the formula depends upon the magnetic influence which the helix exercises, independently of the nucleus of iron which it incloses. The practical consequences which may be deduced from this remarkable law are of considerable importance. Among these, however, I will at present mention only the following. Having found that the amount of magnetism is proportional to the surface of the malleable iron, and taking into account the quantity of iron employed in the electro-magnets, it is ascertained that it is more advantageous to employ in the construction of electro-magnetic machines, rods of small instead of large dimensions; or rather hollow iron, in accordance with my own experiments of 1837, which are found in 'Taylor's Scientific Memoirs,' vol. ii. &c. I cannot pass over in silence the experiments of Prof. Barlow, who, as is well known, proved a long time before that the induction of the terrestrial magnetism upon malleable iron, depends only upon the surfaces, and is almost independent of the thick-

ness. In order to ascertain the law of electro-magnets of different lengths, M. Lenz and I undertook numerous and laborious observations, which were extended even to rods of thirteen feet in length, and keeping in view at the same time the determination of the particular distribution of magnetism in the rods. Among these observations I shall only refer to such as seem most applicable to electro-magnetic machines, and which have yielded results as simple as unexpected. The following table contains the results of some observations made with rods of the same diameter, but of different lengths, covered with electro-magnetic helices, and influenced by a current of the same force. M being the magnetism of the extremities, and n the number of the coils of the helix, we have $\frac{M}{n} = x$, a formula according to which we may calculate the numbers contained in the third column. The numbers in the fourth column are deduced from a series of other observations, made with the same helix of 960 turns, which did not cover the whole length of the rods, but were collected at the extremities only, where they occupied a space of about two inches in length. The helices being the same in all the observations, it was only necessary to divide the magnetism of the extremities by 960, in order to find the numbers of this column.

Table of Experiments upon the Magnetic Forces of Rods of different lengths.

Length of the rods.	Number of Coils.	Mean Value of One Coil, if the Helix occupies the whole length.	Mean Value of One Coil, if the Helix occupies only the extremities.
3′	946	7,334	7,560
2′.5	789	6,993	7,264
2	634	7,402	6,871
1.5	474	7,880	7,491
1	315	7,847	7,573
0.5	163	7,766	7,691
		7,537	7,408

"From these numbers, it will be seen that the influence of one coil of the helix is nearly the same for all the rods, and that their length does not exercise any specific influence. It is only in proportion to the number of the turns or revolutions, and to the force of the current, that the rods can acquire a greater or less amount of magnetism. The small rods even appear to have a slight advantage over large rods, since it has been found by experiments that the actual force of rods of three feet, bears to that of rods of half a foot the ratio of seventy-three to seventy-seven. It is also found, that there is a gain of seventy-five to seventy-four when the whole length of the rods is covered, instead of simply

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collecting the same number of coils around the extremities. The differences between the observations and the simple laws are, as will be judged, quite inconsiderable for practical purposes, and will, in time, I hope, entirely disappear by a complete integration embracing the whole length of the rods, and founded upon the effect of an elementary part of the current. I will now hasten on to the immediate object of my present address. In March 1839, M. Lenz and I presented to the Academy of Sciences at St. Petersburgh, a report, which I shall present to the Association. It contains the result of the experiments by which we have been enabled to establish the remarkable law, *that the attraction of the electro-magnets is proportional to the square of the force of the galvanic current, to the influence of which the rods of iron are submitted.* This law is of the highest practical importance, as it serves for the basis of the whole theory of electro-magnetic machines.

"Before proceeding, I may be permitted to make some remarks concerning an instrument which I laid before the Academy of Sciences, in the commencement of this year. It is destined to regulate the galvanic current, and is of value in many investigations of this kind. During my sojourn in London, Prof. Wheatstone has shown me an instrument, founded on exactly the same principles as mine, and with very inconsiderable modifications and differences. Now, it is quite impossible that he should have had the least notice of my instrument; but as it is probable that its use may be greatly extended, I must add, that while I have only used this instrument for regulating the force of the currents, he has founded upon it a new method of measuring these currents, and of determining the different elements or constants, which enter into the analytical expressions, and on which depends the action of any galvanic combination. It is principally to the measure of the electro-motive force, by those means, that Mr. Wheatstone has directed his attention; and he has shown me, in his unpublished papers, very valuable results which he has obtained by this method.

"While these purely theoretical researches were in progress, I did not fail myself to enter directly upon the question of the practical application of electro-magnetism. Unfortunately, I cannot here give the details either of the experiments which I have made upon a very large scale, or of the machines and apparatus of various kinds which I have constructed. The necessity of multiplying the facts or tangible results—a necessity the more urgent, because the practical applications of this force increased so very rapidly—this necessity, I say, has not allowed me time or leisure to digest and arrange them. I can only here express my readiness to afford any explanation of the details which may be desir-

ed. I will, however, particularly notice the satisfactory results of the experiments made last year with a boat of twenty-eight feet in length and seven and a half feet in width, drawing 2¾ feet of water, and carrying fourteen individuals, which was propelled upon the Neva at the rate of about three English miles in the hour. The machine, which occupied very little space, was set in motion by a battery of sixty-four pairs of platina plates, each having thirty-six square inches of surface, and charged, according, to the plan of Mr. Grove, with nitric and diluted sulphuric acid. Although these results may perhaps not satisfy the exaggerated expectations of some persons, it is to be remembered, that in the first year, namely, in 1838, this boat being put in motion by the same machine, and employing 320 pairs of plates, each of thirty-six square inches, and charged with sulphate of copper, only half this velocity was obtained. This enormous battery occupied considerable space, and the manipulation and the management of it was very troublesome. The judicious changes made in the distribution of the rods, in the construction of the commutator, and lastly, in the principles of the voltaic battery, have led to the successful result of the following year, 1839. We have gone thus on the Neva more than once, and during the whole day, partly with and partly against the stream, with a party of twelve or fourteen persons, and with a velocity not much less than that of the first invented steam-boat. I believe that more cannot be expected from a mechanical force, whose existence has only been known since 1834, when I made the first experiment at Königsberg, in Prussia, and only succeeded in lifting a weight of about twenty ounces, by even this electro-magnetic power.

"I must, on the present occasion, confess frankly and without reserve, that hitherto the construction of electro-magnetic machines has been regulated in a great measure by mere trials; that even the machines constructed according to the indisputable laws established with regard to the statical effects of electro-magnets, have been found inefficient, as soon as we came to deal with motion. Being always accustomed to proceed in a legitimate manner, and feeling great regret at the irregular attempts which were being made every-where, without any scientific foundation, this state of things appeared to me so unsatisfactory, that I could not but direct all my efforts to ascertain clearly the laws of these remarkable machines. I submit the formulæ relative to these laws, which appear to me to recommend themselves as much by their simplicity as by the natural manner in which they develope themselves. Let R. represent all the mechanical resistances acting upon the machine, and v, the uniform velocity with which it moves: we have for the

power or mechanical effect, the expression T = R v. Let n be the number of the coils of the helix which covers the rods; z, the number of the plates of the battery; B, the total resistance of the galvanic circuit; E, the electro-motive force; k, a co-efficient, which depends on the arrangement of the bars, the distance of the poles, and the quality of the iron; we have then for the maximum of the mechanical effect which will be obtained, the expression—

$$T = \frac{z^2 E^2}{4 Bk}.$$

For the velocity, which corresponds to this maximum,

$$\text{II.} \quad v = \frac{B}{kn^2}.$$

For the resistance acting upon the machine,

$$\text{III.} \quad R = \frac{E^2}{4 B}.$$

Lastly, for the economic effect, *i. e.* the duty or the mechanical effect divided by the consumption of zinc in a given time,—

$$\text{IV.} \quad O = \frac{E}{2 k}.$$

"These formulæ may be expressed in the terms:—

"1st. The maximum of mechanical effect which may be obtained from a machine, is proportional to the square of the number of voltaic elements, multiplied by the square of the electro-motive force, and divided by the total resistance of the voltaic circuit. There enters, moreover, into the formula, a factor, which I have designated k, and which depends upon the quality of the iron, the form and disposition of the rods, and the distance between their extremities. The result is, that with reference to some other investigations, which I have made of voltaic combinations, and under similar conditions, the use of platinum, zinc, the resistance being the same, will produce an effect two or three times greater than the use of copper, zinc.

"2nd. Neither the number of the coils of the helix which covers the rods, nor the diameter or the length of the rods themselves, has any influence upon the maximum of the power. It results, therefore, that neither by adding to the length or diameter of the rods, nor by employing a greater quantity of wire, can the power be increased. There is, however, this remarkable fact, that the number of coils disappears from the formula, simply because the force of the machine is in a direct ratio, and the velocity is in an inverse ratio, to the square of this number. It is thus that the number of coils, the dimensions of the rods, and the other constituent parts of an electro-magnetic machine,

should be considered simply as occupying the range of the ordinary mechanisms which serve for the transmission or transformation of the velocity, without increasing the available power. So it would be possible to use, instead of the ordinary wheelwork, rods of greater or less length, or a greater or less quantity of wire, in order to establish between the force and the velocity, the relation which the applications to manufacturing processes may require.

"3rd. The mean attraction of the magnetic rods, or the pressure which the machine can exert, is proportional to the square of the current. This pressure is indicated by the galvanometer, which in this manner performs this function of the manometer of steam-engines.

"4th. The economic effect, *i. e.* the duty or the available power, divided by the consumption of zinc, is a constant quantity, which is exposed most simply by the relation between the electro-motive force and the factor k, which has been previously noticed. I may here repeat, what I stated elsewhere, that by employing platinum instead of copper, the theoretical expenses may be reduced in the proportion of nearly 23 to 14.

"5th. The consumption of zinc, which takes place while the machine is at rest, and does no work at all, is double that which takes place, while it is producing the maximum of power.

"I consider that there will not be much difficulty in determining with sufficient precision the duty of one pound of zinc, by its transformation into the sulphate, in the same manner that in the steam-engine, the duty of one bushel of coal serves as a measure to estimate the effect of different combinations. The future use and application of electro-magnetic machines appears to me quite certain, especially as the mere trials and vague ideas which have hitherto prevailed in the construction of these machines, have now at length yielded to the precise and definite laws which are conformable to the general laws which nature is accustomed to observe with strictness, whenever the question of effects and their causes arises. In viewing on the one hand a chemical effect, and on the other a mechanical effect, the intermediate term scarcely present itself at first. In the present case, it is magneto-electricity, the admirable discovery of Faraday, which we should consider as the regulating power, or, as it may be styled, the logic of electro-magnetic machines."

Prof. Forbes congratulated the Section on the advance made towards introducing electro-magnetism among our useful moving powers. Here was a boat, twenty feet long, capable of containing fourteen people, propelled by it on the Neva, at the rate of three miles an hour a more

successful result than had for many years been attained in the use of steam for a similar purpose.—A gentleman asked the power of the engine.—Prof. JACOBI replied, about 1 or 1.5 horse, but the term horse power was itself vague.--*Reports British Association of Athemeum No.* 678 *October*, 1840.

Third Meeting of the Men of Science of Italy.

The men of science of Italy have selected Florence as the place of their third meeting as well from its being the place which, after having given birth to the revival of literature and the arts, was the cradle of experimental philosophy, as from its being the royal seat where was first entertained the thought of this new and great institution, and in which a high-minded prince has raised to the divine Galileo a temple wherein his manuscripts and apparatus will be preserved as a large part of the glorious inheritance of Italy.

It occurred to every one that the friends of science assembled in Florence, in the midst of such numerous splendid monuments of art and science of past and present times, would feel incited by these recollections to pursue the course gloriously opened by our forefathers, and by so doing would pay the deserved tribute of their gratitude to the prince who encouraged the progress of the science, and promoted the honour of his country.

It is satisfactory to announce, that the Grand Duke, our sovereign, approving the selection of his capital for the place of the third meeting of the Italian Savans, and having promised to aid its objects in every manner with his royal bounty and patronage, permits that the meeting should commence the 15th of September, 1841, to continue to the end of that month.

The regulations determined on at the first meeting in Pisa have conferred the right of taking part in the scientific meeting on the Italians belonging to the principal academies or scientific societies for the advancement of natural knowledge; the professors of the physical and mathematical sciences; the directors of the higher branches of study, or of the scientific establishments of the various states of Italy; and the chief officers of the corps of engineers and artillery. Foreigners coming under any of the above descriptions will be also admitted to the meeting.

We feel sure that our brethren who enjoy the privilege of attending the meeting will gladly avail themselves of it, and thus contribute to the

great advantages which it confers upon the whole body of speculative and practical sciences. It is hoped that the invitation to scientific foreigners will prove not less effectual, as the estimation in which they hold Italian science is a pledge that they will be anxious to witness all that Italy has done and is doing, and to afford their co-operation in the noble undertaking.

A future advertisement will announce the final and special arrangements for the meeting and for the accommodation of those who may attend it. In the mean time, it is satisfactory to state that there have been elected to the office of Assessors, Prof. Gaetano Georgini, Superintendent of the Studies of the Grand Duchy, and Cav. Giuseppe Gazzeri, Prof. in the University of Pisa.—*Ann. and Mag. of Nat. Hist.*

Florence, Dec. 28, 1840.

The President General,
Marchese Cosimo Ridolfi.

The Secretary General,
Cav. Ferdinando Tarturi.

Dr. Lush on the Madi, or Chili Oil-seed, Madia sativa.

"We insert a paper by Dr. Lush, of the Medical Establishment of this Presidency, which brings to notice a new seed, called the 'Madi, or Chili Oil-seed,' which promises to be a valuable adjunct to the plants of that class in this country. It appears to flourish in a high and dry land, and will probably succeed in the Deccan and Southern Mahratta country. Dr. Lush has presented it to the Agricultural and Horticultural Society in Bombay, by whom it will be tested, and its uses fully developed.

"The demand which now exists for oil-seeds from British India has caused much attention to be drawn towards such products as may be raised in sufficient quantities, and at such a price, as may ensure them a permanent place among Indian exports to England. On the western side, or the districts under Bombay, we find, that for field produce as oil-seeds we must look out for such articles of cultivation as will not require irrigation, seeing that the sesamum, the kerday, the linseed, and the castor-oil are all produced in different districts of our Presidency as dry crops. Besides those already mentioned, we find a quickly-growing plant in the Deccan, sown usually with the ordinary crops of bajree and pulse; viz. the *Verbesina sativa* (since called *Guizotia oleifera*), or Black Til. This plant is valuable to the natives from its quick and hardy growth in a dry climate and scanty monsoon; but from the small quantity of oil in proportion to the bulk, and the inferior quality of that oil, it is not a plant likely to attract attention beyond local wants.

"The Madi (*Madia sativa*) is a plant of the same habit, and allied in botanical characters to the *Verbesina.* It has lately been grown in England by one or two experimentalists, in the hope of obtaining an indigenous oil of a superior quality. Professor Lindley, who has grown a portion at the Horticultural Society's Garden at Chiswick, is of opinion that the climate of England is too damp and cold for the Madi; and on my requesting to be furnished with seed for trial in the dry parts of India, he kindly sent me a liberal supply (which I have brought here overland), and agrees with me in the opinion that it will stand a good chance in the high and dry lands of the Deccan and other similar districts of India. A plant requiring no more care in the cultivation than the black til of the Deccan, and producing an oil second only to that of the almond and olive, and superior to the sesamum, (the common 'sweet oil' of Western India), must prove a valuable addition to the produce of the country, and as such I commit it to the care of the Agricultural and Horticultural Society of Bombay without further recommendation, merely subjoining a notice of what has already been mentioned by authors about this hitherto neglected plant.

"DeCandolle, in his 'Prodromus,' gives a full description of the plant, and notices shortly that the seed is used for making an oil. This oil, however, does not seem to have attracted the notice of commercial persons, and the only account of it I could procure in London was kindly pointed out to me by my friend Professor Don, in a work published in the year 1711, (in the library of the Linnæan Society of London), 'Histoire des Plantes Médicinales de Perou et de Chili,' by Mons. Feuillée. Of this account the follwing is a translation:—

"'An admirable oil is made from the seeds of this plant throughout all Chili. The natives make use of it not only as a local application to assuage pain, anointing with it the parts affected, but also as a condiment, and besides for burning in lamps. I found it,' says M. Feuillée, 'sweeter and of a more agreeable taste than the greater part of our olive oils; its colour is the same. There are no olives in Chili, and whatever olive oil is found there is brought from Peru, where a large quantity is made.'

"I beg to present the Society with an original coloured drawing of this plant, made for me in August last at Chiswick, by Mr. Hart, lately draughtsman to the Botanical Register.—Charles Lush, M.D."

—*Bombay Gazette, 26th November,* 1840.